

From the Department of Clinical Neuroscience,
Karolinska Institutet, Stockholm, Sweden

CHILD AND ADULT HOMICIDE IN SWEDEN: EPIDEMIOLOGICAL AND FORENSIC FEATURES

Jonatan Hedlund



**Karolinska
Institutet**

Stockholm 2018

Cover: *Död fågelunge bland kuber* by Lena Svedberg (1946–1972). Nearly fifty years after her untimely passing, Lena Svedberg is widely regarded as one of the great artists of her generation. Her works often included bizarre and appalling motives used for satirical purposes. During the latter part of her life, Svedberg was plagued by ill health and drug misuse. Sadly, at the mere age of 26 years, she passed away after having thrown herself out of a window of her fifth-floor Stockholm apartment.

The cover image was reproduced with permission from Bildupphovsrätt i Sverige, and all previously published papers were reproduced with permission from the publishers.

Published by Karolinska Institutet.

© Jonatan Hedlund, 2018

ISBN 978-91-7676-942-3

Printed by E-print AB 2018

Child and Adult Homicide in Sweden: Epidemiological and Forensic Features.

THESIS FOR DOCTORAL DEGREE (Ph.D.)

By

Jonatan Hedlund

This thesis will be publicly defended in lecture hall 9Q Månen, Alfred Nobels Allé 8, Huddinge, on June 5, 2018, at 9:30 AM.

Principal Supervisor:

Ph.D. Joakim Sturup
Karolinska Institutet
Department of Clinical Neuroscience
Centre for Psychiatry Research

Co-supervisors:

Professor Johan Ahlner
Linköping University
Faculty of Medicine and Health Sciences
Division of Drug Research

Professor Marianne Kristiansson
Karolinska Institutet
Department of Clinical Neuroscience
Centre for Psychiatry Research

Associate Professor Thomas Masterman
Karolinska Institutet
Department of Clinical Neuroscience
Centre for Psychiatry Research

Opponent:

Associate Professor Peter Andiné
University of Gothenburg
Department of Psychiatry and Neurochemistry
Centre for Ethics, Law and Mental Health

Examination Board:

Professor Christina Dalman
Karolinska Institutet
Department of Public Health Sciences
Division of Public Health Epidemiology

Professor Bo Runeson
Karolinska Institutet
Department of Clinical Neuroscience
Centre for Psychiatry Research

Professor Marie Torstensson Levander
Malmö University
Department of Criminology
Faculty of Health and Society

*These events are unparalleled in the course of human affairs,
and seem to us to merit the attention of reflecting persons,
not as matters to be wondered at for their atrocity,
but to be viewed in connexion with the causes that led to them,
and the means that might have prevented them.*

Excerpt from “Atrocious murders in Edinburgh”, published in
The Boston Medical and Surgical Journal in 1829.
The authors are not disclosed.

TO MY FAMILY,
AND IN LOVING MEMORY OF
JEANNE AHLBERG HEDLUND
AND RICKARD HEDLUND

ABSTRACT

Homicide occurs worldwide and is often regarded a major public-health concern. The studies comprising the present thesis were conducted with a view to advancing knowledge of both child and adult homicide from the viewpoints of different branches of forensic science.

In **study I**, forensic-toxicological data for the years 2007–2009 were retrieved for 120 perpetrators and 265 victims of homicide. Ethanol was the most commonly detected substance, followed by benzodiazepines, which were significantly more common in offenders than victims. Also, perpetrators of homicide–suicide significantly more often displayed negative toxicology than non-suicide homicide offenders. Moreover, victims in unsolved cases were significantly more often positive for narcotics than victims in solved cases. In **studies II and III**, 200 adult homicide victims and 105 adult homicide offenders were compared by means of logistic regression with 1629 (study II) and 1643 (study III) controls who had lost their lives in vehicle accidents. We found (study II) that ethanol conferred 2-fold and 4-fold risks of homicide victimization and offending, respectively; after stratification by sex, risk estimates were about 3-fold greater in females than males for both homicide offending and victimization. In study III, by comparing prescription data with toxicology data, we found that discontinued treatment with antidepressants conferred a significant 6-fold risk of homicide offending, but no risk increase with regard to homicide victimization; with regard to discontinued treatment with antipsychotics and mood stabilizers, a 7-fold risk was found for homicide offending. For GABA-ergic hypnotics, 2–5-fold risks were found for homicide offending and victimization irrespective of whether treatment had been prescribed or not. In **study IV**, a range of characteristics from intra- and extra-familial child homicides during 1992 through 2012 are reported. Using Poisson regression, an average yearly decline of 4% in child homicides was uncovered. Substance misuse was found to be uncommon (8%) among child homicide offenders. Prior violent offenses were more common among perpetrators of filicide than filicide–suicide (18% versus 7%); and about 20% of offenders in each group had previously received psychiatric inpatient care. Surprisingly, a third of the extra-familial offenders fulfilled diagnostic criteria for an autism-spectrum disorder. In **study V**, using a matched case-control design, we found that prior inpatient care conferred a significantly elevated 5-fold risk of filicide victimization. The result was driven by a particularly high risk in females, as no significant risk increase was found in males after stratification by sex.

In conclusion, toxicological findings indicate that ethanol and benzodiazepines are common in homicide offenders and victims; increased risks of homicidal outcome conferred by alcohol were uncovered, as well as increased risks of homicide offending conferred by the use of GABA-ergic hypnotics and the discontinued use of other psychotropic medications. Finally, rates and characteristics of child-homicide offenders and victims were reported, along with risks of filicide victimization conferred by prior healthcare use. Ideally, some of our results might be implemented in everyday healthcare practice and also be useful for homicide investigators and offender profilers.

SAMMANFATTNING PÅ SVENSKA

Dödligt våld förekommer över hela världen och betraktas ofta som ett hot mot folkhälsan. Delarbetena i det föreliggande avhandlingsarbetet har genomförts i syfte att öka kunskapen om dödligt våld med hjälp av flera av disciplinerna inom den forensiska vetenskapen.

I **delarbete I** rapporterade vi toxikologiska fynd från 120 gärningspersoner och 265 offer i fall med dödligt våld under perioden 2007 till 2009. Etanol förekom mest frekvent, följt av bensodiazepiner, vilka förekom signifikant oftare hos gärningspersonerna än offren. De gärningspersoner som tog sitt liv efter gärningen uppvisade negativ toxikologi i större utsträckning än de som inte gjorde det. Offren i ouppklarade fall uppvisade signifikant oftare positiva analysresultat för narkotika än offren i de uppklarade fallen. I **delarbetena II och III** jämfördes 200 offer och 105 förövare med 1629 (delarbete II) respektive 1643 (delarbete III) individer som hade dött i farkostrelaterade olyckor. I delarbete II fann vi att positivt utfall för etanol medförde en två- till fyrfaldigt ökad risk att falla offer för, respektive begå, dödligt våld; hos kvinnor utföll motsvarande risker trefaldigt högre än hos män. I delarbete III jämförde vi förskrivningsdata med toxikologi och kunde se att avbruten behandling med antidepressiva läkemedel medförde en sexfaldig risk att begå dödligt våld, medan avbruten behandling med antipsykotiska eller stämningsstabiliserande läkemedel medförde en sjufaldig sådan risk. Beträffande pågående användning av GABA-erga preparat fann vi två- till femfaldiga riskökningar för inblandning i dödligt våld – oavsett om läkemedlen hade förskrivits eller anskaffats på annan väg. I **delarbete IV** rapporterade vi en rad omständigheter rörande intra- och extrafamiljära fall av dödligt våld mot barn under perioden 1992 till 2012; bland annat framkom en årlig genomsnittlig minskning om 4% efter analys med poissonregression. Tidigare domar för våldsbrott var vanligare hos dem som hade dödat sina barn jämfört med dem som dessutom hade tagit sitt eget liv (18 % versus 7 %); därtill fann vi att cirka 20 % av förövarna i båda de nämnda grupperna vid något tillfälle hade vårdats inläggande inom psykiatrin. En missbruksproblematik kunde konstateras endast hos 8 % av de gärningspersoner som dödat barn och därefter undersökts rättspsykiatriskt, medan en tredjedel av gärningspersonerna i de extrafamiljära fallen hade bedömts förete en autismspektrumstörning. I **delarbete V** fann vi att tidigare slutenvård till följd av skador eller förgiftningar medförde en signifikant femfaldig risk att falla offer för dödligt våld begånget av en förälder; riskökningen kunde samtidigt konstateras vara en könsbunden effekt – när pojkar undersöktes separat noterades ingen signifikant förhöjd risk.

Sammantaget konstateras att alkoholintag samt användning av GABA-erga läkemedel tycks medföra en ökad risk för inblandning i dödligt våld. Vidare framkommer att avbruten behandling med antidepressiva, antipsykotiska eller stämningsstabiliserande läkemedel förefaller medföra en ökad risk att begå dödligt våld. En minskad frekvens av dödligt våld mot barn konstateras över tid, och det presenteras omständigheter som synes vara associerade med en ökad risk för sådant våld. Förhoppningsvis kan fynden i föreliggande avhandling åtminstone delvis implementeras i sjukvården och möjligen även underlätta vid polisiärt profileringsarbete.

LIST OF SCIENTIFIC PAPERS

- I. **Hedlund, J.**, Ahlner, J., Kristiansson, M., & Sturup, J. (2014). A population-based study on toxicological findings in Swedish homicide victims and offenders from 2007 to 2009. *Forensic Science International*, 244, 25–29.
- II. **Hedlund, J.**, Forsman, J., Sturup, J., & Masterman, T. (2018). Pre-offense alcohol intake in homicide offenders and victims: a forensic-toxicological case-control study. *Journal of Forensic and Legal Medicine*, 56, 55-58.
- III. **Hedlund, J.**, Forsman, J., Sturup, J., & Masterman, T. (2017). Psychotropic medications in Swedish homicide victims and offenders: a forensic-toxicological case-control study of adherence and recreational use. *Journal of Clinical Psychiatry*, 78, e797–e802.
- IV. **Hedlund, J.**, Masterman, T., & Sturup, J. (2016). Intra- and extra-familial child homicide in Sweden 1992–2012: a population-based study. *Journal of Forensic and Legal Medicine*, 39, 91–99.
- V. Bäckström, B.*, **Hedlund, J.***, Masterman, T., & Sturup, J. Injury-related healthcare use and risk of filicide victimization: a population-based case-control study. (*submitted*)

*These authors contributed equally

CONTENTS

1	Introduction	1
1.1	Lethal violence in adults.....	1
1.1.1	Background	1
1.1.2	Substance misuse in relation to violence and homicide	3
1.1.3	Alcohol use in relation to violence and homicide	4
1.1.4	Mental disorder, violence and homicide	5
1.1.5	Toxicological findings in perpetrators and victims of homicide	6
1.2	Lethal violence against children	7
1.2.1	Background, epidemiology and definitions	7
1.2.2	Common methodological challenges in child-homicide research	9
1.2.3	Mental disorders in child-homicide offenders.....	10
1.2.4	Neonaticide.....	11
1.2.5	Maternal versus paternal filicide.....	12
1.2.6	Filicide–suicide and familicide	12
1.2.7	An evolutionary perspective on filicide	13
1.3	Adherence	14
1.3.1	Defining adherence.....	14
1.3.2	Measuring adherence.....	14
1.4	Toxicology	16
1.4.1	Definition and basic principles	16
1.4.2	Forensic-toxicological aspects of alcohol	17
1.4.3	Methods used for forensic-toxicological analysis	18
2	Aims and hypotheses	19
2.1	Study I.....	19
2.2	Study II.....	19
2.3	Study III	19
2.4	Study IV	19
2.5	Study V	19
3	Material and methods.....	20
3.1	Definitions.....	20
3.1.1	Homicide and homicide–suicide.....	20
3.1.2	Solved case.....	20
3.1.3	Substance misuse.....	20
3.1.4	Child and parent	21
3.2	Databases and registries	21
3.2.1	The Cause of Death Registry	21
3.2.2	Forensic-psychiatric evaluations.....	22
3.2.3	The National Registry of Criminal Convictions.....	23
3.2.4	The National Patient Registry	24
3.2.5	The Prescribed Drug Registry.....	24
3.2.6	RättsBase.....	25

3.2.7	Statistics Sweden and the Total Population Registry	25
3.2.8	The Swedish Tax Agency	25
3.2.9	ToxBase.....	25
3.3	Subjects	26
3.3.1	Studies I–III	26
3.3.2	Study IV.....	28
3.3.3	Study V	28
3.4	Statistics.....	29
3.4.1	The probability value and the confidence interval.....	29
3.4.2	Regression analysis	30
3.4.3	The chi-squared test and Fisher’s exact test	31
3.4.4	The toxicology-based studies	31
3.4.5	The child-homicide studies	31
4	Results.....	33
4.1	The toxicology-based studies.....	33
4.1.1	Study I	33
4.1.2	Study II	33
4.1.3	Study III.....	33
4.2	The child-homicide studies.....	34
4.2.1	Study IV.....	34
4.2.2	Study V	35
5	Discussion.....	36
5.1	The toxicology-based studies.....	36
5.1.1	Study I	36
5.1.2	Study II	37
5.1.3	Study III.....	38
5.2	The child-homicide studies.....	41
5.2.1	Study IV.....	41
5.2.2	Study V	43
5.3	Methodological considerations	45
5.3.1	Bias	45
5.3.2	Confounding	45
5.3.3	Strengths, limitations and sources of bias and confounding	45
6	Ethical considerations	48
7	Conclusions and future perspectives	50
8	Acknowledgements	52
9	References.....	53

LIST OF ABBREVIATIONS

ADHD	Attention-deficit/hyperactivity disorder
aOR	Adjusted odds ratio
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
FPE	Forensic-psychiatric evaluation
GABA	γ -aminobutyric acid
GC–MS	Gas chromatography–mass spectrometry
GHB/GBL	γ -hydroxybutyric acid/ γ -butyrolactone
HS–GC	Headspace gas chromatography
ICD	International Classification of Diseases and Related Health Problems
IRR	Incidence rate ratio
MPR	Medication possession ratio
n	Number
NBFM	National Board of Forensic Medicine
NPR	National Patient Registry
NRCC	National Registry of Criminal Convictions
OR	Odds ratio
p	Probability
WHO	World Health Organization
Z drugs	Zopiclone, zolpidem and zaleplon

1 INTRODUCTION

1.1 LETHAL VIOLENCE IN ADULTS

1.1.1 Background

1.1.1.1 Homicide

Homicide is arguably one of the most serious crimes known to humankind and it has a great impact on the sense of security across most, if not all, societies (United Nations Office on Drugs and Crime, 2014). In 2012, almost half a million people were killed in homicidal incidents worldwide, the majority of whom were younger than 30 years (United Nations Office on Drugs and Crime, 2014). Homicide rates vary considerably across the globe; rates are low (less than 1 per 100 000 inhabitants) in many countries within the European Union and Asia, whereas they generally are elevated in Eastern European countries and the Americas (see Figure 1) (Granath et al., 2011; United Nations Office on Drugs and Crime, 2014). Since the 1990s, homicide rates have dropped in Europe, North America and Australia; the reasons for this decline have been extensively debated from the viewpoints of different criminological theories (Aebi & Linde, 2014; Lehti, 2014). However, the homicide drop is far from universal; it has been suggested that some of the poorest countries have experienced an escalating homicide trend, with an overall pattern that resembles the global economic inequalities that tend to make the rich countries even richer and the poor ones even poorer and more dangerous (Weiss, Santos, Testa, & Kumar, 2016). A homicide–poverty association has also been uncovered in rich countries such as the U.S. (Pridemore, 2011), and a recent ecological study from that country found that greater per-capita investments in social and public-health services, targeting individuals living in poverty, were associated with significantly lowered homicide rates on a state level (Sipsma et al., 2017).

Historically, homicide rates declined substantially across Europe between the 1300s and the mid 1950s, when an all-time low was recorded (Liem & Pridemore, 2012). Interestingly, the per-capita homicide rate in Sweden was about the same in the year 1750 as in the year 2000, although some fluctuations were noted during the period between those years; a rise was evident in the first part of the nineteenth century, and a low level was seen in the period between the World Wars (von Hofer, 2003). In Sweden, for the period 1990 to 2010, a decreased incidence of male-perpetrated as well as female-perpetrated homicides has been reported (Trägårdh, Nilsson, Granath, & Sturup, 2017).

For the purpose of most studies within the field, homicide is defined as the “unlawful death purposefully inflicted on a person by another person”, a definition that thus excludes unintentional deaths (e.g., deaths resulting from accidents caused by someone driving under the influence of alcohol or drugs), as well as executions by governments following death sentences (United Nations Office on Drugs and Crime, 2014). In Northern European countries, such as Finland and Sweden, homicidal incidents, to a large extent, are the result of

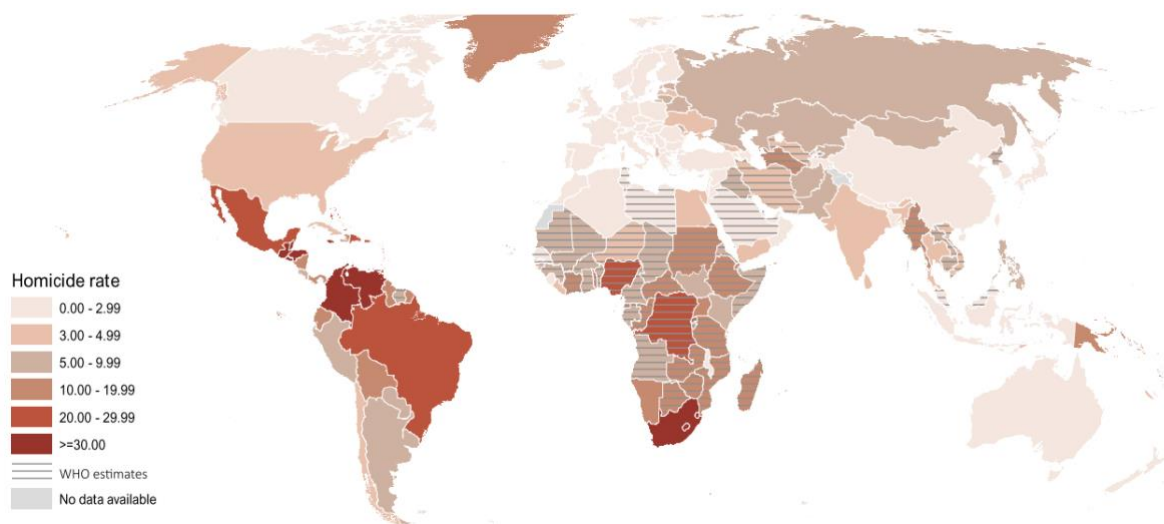


Figure 1. Homicide rates by country or territory (2012 or latest year) per 100 000 inhabitants. The data are based on the United Nations Office of Drugs and Crime Homicide Statistics 2013, which are accessible at <https://www.unodc.org/gsh/en/data.html>. The figure is reprinted from the same organization’s publication “Global Study on Homicide 2013”.

conflicts between adult males intoxicated with alcohol (Granath et al., 2011). Homicides in these countries are, to a lesser extent, the result of activities in a criminal milieu – a circumstance that is believed to contribute to high clearance rates (above 85%) (Sturup, Karlberg, & Kristiansson, 2015). In recent years, however, a decreasing clearance rate has been found in the subgroup of firearm-perpetrated homicides committed against criminally active males (Granath & Sturup, 2018).

1.1.1.2 Homicide–suicide

Homicide–suicide is a subtype of lethal violence which is characterized by offender suicide post homicide. The rates of homicide–suicide vary considerably between different countries; the perpetrators of such events are likely to be older than perpetrators of homicide-only cases, and the victims are often female intimate partners (either former or current) (Liem, Barber, Markwalder, Killias, & Nieuwbeerta, 2011; Panczak et al., 2013). In Sweden, a declining incidence of homicide–suicides has been reported for the period 1991–2010 (Regoeczi, Granath, Issa, Gilson, & Sturup, 2016). Since homicide–suicide offenders cannot be interrogated post offense, the circumstances that precede such tragic events are sometimes difficult to disentangle, and police investigators and researchers may have to rely on notes left behind by the perpetrator as the only source of information (Sturup & Caman, 2015; Weeke & Oberwittler, 2017). It has been debated whether homicide–suicides have more in common with suicides – and therefore should be thought of as “extended suicides” – or whether the homicidal event is the primary motivation underlying these violent acts (Manning, 2014; Marzuk, Tardiff, & Hirsch, 1992). By investigating the epidemiology of homicide–suicide, Large and co-workers (2009a) found homicide–suicide to be closer to homicide than suicide (in epidemiological terms) in regions with high homicide rates.

Scholars have long attempted to increase knowledge of the homicide–suicide phenomenon by discussing it against a backdrop of different theories, such as psycho-evolutionary theory, psychodynamic theory, social integration theory and strain theories (Liem, 2010). Unfortunately, no theory alone has proved sufficient to give a full understanding of homicide–suicide (Liem, 2010). Recently, a homicide–suicide classification scheme was proposed by Knoll (2016), who also pointed to the importance of conducting psychological autopsies to gain knowledge in this field, as well as the importance of studying extremely rare methods of homicide–suicide, such as those mediated by aircrafts (of which the 2015 Germanwings disaster probably is most well-known).

1.1.2 Substance misuse in relation to violence and homicide

The association between substances of abuse and violence is well established (Boles & Miotto, 2003; Golenkov, Large, Nielssen, & Tsymbalova, 2016; Haggård-Grann, Hallqvist, Långström, & Möller, 2006; Johnson & Belfer, 1995; Lundholm, Haggård, Möller, Hallqvist, & Thiblin, 2013; Shaw et al., 2006; Tomlinson, Brown, & Hoaken, 2016). One of the latest additions to the literature is a meta-analysis of meta-analyses (a so-called “meta-meta-analysis”) in which robust associations between alcohol and illicit drugs, on the one hand, and violence, on the other hand, were demonstrated across different populations and study types (Duke, Smith, Oberleitner, Westphal, & Mckee, 2018). Some 30 years ago, Goldstein (1985) proposed a model for the mechanisms of violence in the context of substance misuse. Three principal pathways were suggested: (i) violence resulting from the direct pharmacological effects of a substance (e.g., intoxication and symptoms of withdrawal); (ii) violence stemming from the need to obtain money for drugs, e.g., through robbery (the economic–compulsive model); and (iii) systemic violence resulting from activities on illicit drug markets, where disputes often are solved violently (Goldstein, 1985). The causal association between alcohol and violence is unequivocal (Tomlinson et al., 2016), whereas a causal association has not been firmly established in the case of illicit substances (Kuhns & Clodfelter, 2009). Several theories have been put forth to explain the relationship between alcohol and aggression: (i) the disinhibition model, which hypothesizes that inhibiting processes in the frontal cortex are directly weakened by ethanol; (ii) the expectancy model, which states that an individual’s learned beliefs about alcohol mainly underlie aggression; and last, (iii) the indirect causal model, which highlights the complexity of the alcohol–aggression relationship by acknowledging moderating factors such as emotional and situational cues (Kuhns, Exum, Clodfelter, & Bottia, 2013). In their comprehensive review, Tomlinson and co-workers (2016) summarize the current body of knowledge regarding the use of recreational substances and human aggression. With respect to illicit substances, strong associations have been found for cannabis, cocaine and heroin – associations that, however, can likely be accounted for by a third variable, such as personality traits or environmental influences (Tomlinson et al., 2016). In a fairly recent Finnish study based on prescription data, non-recreational use of benzodiazepines and opioids conferred an increased risk of homicide offending (Tiihonen et al., 2015).

1.1.3 Alcohol use in relation to violence and homicide

Several studies using aggregate-level data have investigated associations regarding, on the one hand, alcohol consumption, alcohol availability or drinking patterns and, on the other hand, rates of homicide or violence (see, for instance, references [Landberg & Norström, 2011; Parker et al., 2011; Ramstedt, 2011; Stickley & Razvodovsky, 2012]). In a Russian dataset, it has been shown that a 1 liter-per capita increase in alcohol sales was associated with an increased homicide risk of between 5% and 6% (Stickley & Razvodovsky, 2012). Figures were substantially higher when vodka was analyzed separately, which led the authors to conclude that a shift in beverage preference away from distilled spirits might contribute to a reduction of homicide rates (Stickley & Razvodovsky, 2012). In a Swedish study that made use of Australian data, a 1 liter-per capita sales increase was associated with an 8% homicide-rate increase; however, in that study, the effect of alcohol on homicide was found to mainly be driven by beer consumption, and the author advocated limiting beer intake (rather than vodka consumption) as a means of reducing homicide rates (Ramstedt, 2011). A sales increase of the same magnitude was, in a study based on joint U.S.–Russian data, associated with a 10% rise in homicide rates, although the absolute effect of alcohol on homicide was larger in Russia than in the U.S. owing to a higher base rate of homicide in Russia (Landberg & Norström, 2011). Further, Pridemore (2002) found a 0.25% homicide-rate increase in response to a 1% increase in alcohol sales in a dataset from post-Soviet-era Russia. He noted that the Russian tradition of heavy episodic binge drinking, which usually results in rapid intoxication – in parallel with the customary Russian semi-private drinking settings – creates a context with a heightened risk of lethal outcome.

In a study that examined drinking patterns with respect to homicide rates in Eastern Europe, Bye (2008) found a stronger association in countries with a more hazardous drinking pattern. However, using a U.S. dataset, Norström (2011) only found mixed support for the hypothesis that an intoxication-oriented drinking pattern was more strongly related to homicide than a more temperate one. In a subsequent study that made use of aggregate-level data from 83 nations, Hockin and co-workers (2017) found that countries with riskier drinking patterns did not have higher homicide rates than countries with less risky drinking patterns. The authors were also interested in threshold effects – i.e., whether per-capita increases in alcohol consumption would affect homicide rates exclusively above a certain level of consumption – but their data did not support the presence of such effects (Hockin et al., 2017). Moreover, a significant effect of alcohol on homicide rates was found in a large pooled dataset collated from several European countries (Norström & Ramstedt, 2005). In a scaled-down regional perspective, ecological studies have found positive correlations between, on the one hand, liquor-outlet density, and on the other hand, violence (Lipton & Gruenewald, 2002) and violent death (Escobedo & Ortiz, 2002).

Pridemore and Eckhardt (2014) have highlighted several key differences between alcohol-related and non-alcohol-related homicides; the former being more likely to occur during the night and on weekends and less likely to be carried out to hide crimes, to be profit-motivated or to occur between strangers.

1.1.4 Mental disorder, violence and homicide

There are compelling data suggesting a link between mental illness and violence, including homicide – with regard to both victims and offenders (Bennett et al., 2011; Fazel, Långström, Hjern, Grann, & Lichtenstein, 2009; Rodway et al., 2014; Taylor & Kalebic, 2018; van Dorn, Volavka, & Johnson, 2012). For instance, in a Swedish study, 90% of individuals who had committed homicide or attempted homicide had at some time been diagnosed with a psychiatric disorder (Fazel & Grann, 2004), and high rates of mental illness have also been noted in other countries (Golenkov et al., 2016; Martone et al., 2013). In the Swedish sample, 20% of homicide offenders had at some time been diagnosed with a psychotic disorder, and there has been an ongoing scholarly debate as to whether such disorders confer a heightened violence risk or whether associations are better accounted for by concomitant substance misuse (Bennett et al., 2011; Coid, Ullrich, Bebbington, Fazel, & Keers, 2016; van Dorn et al., 2012). Recently, Coid and co-workers (2016) conducted a meta-analysis in which they found a robust and independent association between paranoid ideation and violence; however, the association between psychotic disorders and violence remained dependent upon other factors, in accordance with prior findings (Fazel, Gulati, Linsell, Geddes, & Grann, 2009). In another study from Coid's group (2015), the importance of assessing temporal proximity between active symptoms of psychosis and violence was highlighted. Moreover, in their systematic review and meta-analysis, Nielssen and Large (2010) found that the risk of homicide offending was elevated in individuals who suffer from a first-episode psychosis compared to individuals with psychotic states that had been treated – findings that highlight early diagnosis and treatment of first-episode psychosis as a potential means to reduce homicidal violence. In another important meta-analysis from the same group (Large, Smith, & Nielssen, 2009b), the authors found no support for the widely held belief, proposed by Coid (1983), that the rate of homicides committed by individuals with schizophrenia is unrelated to the total homicide rate. Large and co-workers pointed out that a constant rate of homicides committed by individuals with schizophrenia would imply a relation between those events, on the one hand, and the epidemiology of the illness – rather than other factors in society – on the other hand. Thus, as the authors concluded, homicides perpetrated by schizophrenic individuals and other homicides likely have common etiological factors – a finding which suggests that similar measures could be beneficial in preventing these different events (Large et al., 2009b).

Violent offending has been linked not only to psychotic states, but also to depression (Fazel et al., 2015) and bipolar disorder (Fazel, Lichtenstein, Grann, Goodwin, & Långström, 2010; Nielssen, Malhi, & Large, 2012; Volavka, 2013; Yoon et al., 2012). In a Danish cohort study, increased rates of violent offending were found across several psychiatric disorders, not only those previously mentioned (Stevens, Laursen, Mortensen, Agerbo, & Dean, 2015). The study design required that diagnostic assessments had been performed prior to the offenses, thus fulfilling the only truly essential criterion for establishing causality as proposed by Hill (1965). Moreover, an association between deliberate self-harm and violent criminality – independent of concurrent psychiatric disorder – has been shown in a large cohort study from

Sweden (Sahlin et al., 2017). Further, a recent review has examined the association between type of mental illness in homicide offenders and the means of violence used to perpetrate their lethal acts (Abreu Minero, Barker, & Bedford, 2017); the authors found significant associations between schizophrenia/delusional disorder and sharp violence, and between mood disorders and asphyctic violence.

With regard to preventive efforts, a systematic review by Witt and co-workers (2013) found several modifiable risk factors for violence in psychotic patients, e.g., non-adherence to medication and recent drug or alcohol misuse. The findings are in line with those of Sher and co-workers, who, in a second review, proposed that prevention of homicidal behavior in males should focus on ensuring long-term treatment and compliance in high-risk groups (Sher & Rice, 2015). Using a case-crossover design, Sariaslan and co-workers (2016) turned their attention to the temporal mechanisms that link risk factors with violence. Specifically, they showed that certain “triggers” (i.e., proximal risk factors, such as substance intoxication or exposure to violence) increased the risk of violent criminality in the exposed person during the week following the trigger event; risks were elevated not only in psychotic and bipolar patients, but also in unaffected controls (Sariaslan et al., 2016). Further, in a Canadian study that included schizophrenic offenders (Rezansoff, Moniruzzaman, Fazel, McCandless, & Somers, 2017), rates of violent re-offending were compared across different levels of adherence to antipsychotic treatment. Using a novel approach, adherence was treated as a continuous variable rather than a binary one. As could be expected, lower adherence levels (defined as access to medication less than 80% of the time) were significantly associated with violent offending – a finding that points to the possibility of reducing violence by increasing the level of adherence in these patients (Rezansoff et al., 2017). Last, a Swedish registry-based study that utilized an intra-individual design, found, in individuals treated with antipsychotics and mood stabilizers, reductions in violent criminality of 45% and 24%, respectively, during periods of treatment compared to periods off medication (Fazel, Zetterqvist, Larsson, Långström, & Lichtenstein, 2014). The results seem to imply an association between criminal offending and the disorders for which such medications are prescribed. However, it should be emphasized that neither that study – nor the previously mentioned Canadian study (Rezansoff et al., 2017) – made use of toxicological data, which raises a question as to what extent participants were truly adherent to medication.

1.1.5 Toxicological findings in perpetrators and victims of homicide

In a comprehensive meta-analysis, Kuhns and co-workers found that 48% of homicide offenders were reported to be positive for alcohol at the time of the offense (Kuhns et al., 2013). Of note, only one of the included studies supplied actual toxicological data, which points to a common problem in this field: the relative paucity of toxicological studies on offenders owing to the difficulty of conducting biological sampling within a reasonable time frame post offense. Nevertheless, in a review by Darke on the toxicology of homicide, positive results for alcohol have been shown to range from one-third to two-thirds of all sampled subjects; and illicit substances – most often cocaine and cannabis – have also

frequently been detected, albeit at lower rates (Darke, 2010). However, as in the case of Kuhn's meta-analytical work (Kuhns et al., 2013), there is also a dearth of toxicology-based studies included in Darke's review (Darke, 2010) – despite its ambition to deal explicitly with toxicology. For example, to shed light on the “toxicology” of homicide offenders, Darke included a study based on self-reported alcohol use in juveniles (Roe-Sepowitz, 2008), as well as a study in which alcohol use was determined by telephone interviews with family members of victims of femicide or attempted femicide (Sharps, Campbell, Campbell, Gary, & Webster, 2001).

The toxicology of victims of homicide has been studied more extensively and, by and large, shows similar results: alcohol is present in about 50% of subjects (Kuhns, Wilson, Clodfelter, Maguire, & Ainsworth, 2011) at the time of death, and illicit substances (most often psychostimulants, opioids and cannabis) at lower rates (Darke, 2010; Darke & Duflou, 2008). In a meta-analysis of homicide victims, the rates of positive toxicology for cannabis (marijuana), cocaine and opioids were found to be 6%, 11% and 5%, respectively (Kuhns, Wilson, Maguire, Ainsworth, & Clodfelter, 2009). It has been argued that the toxicological similarities between victims and offenders can be seen in view of the situational context that precedes many homicides: in a typical substance-related case, animosities develop between intoxicated males and the respective fates of the combatants is many times determined by happenstance (Darke, 2010). Interestingly, the toxicological pattern in victims reflects the way different recreational substances are consumed: alcohol displays peaks during the night and on weekends, whereas illicit substances are detected more evenly throughout the week (Darke & Duflou, 2008).

1.2 LETHAL VIOLENCE AGAINST CHILDREN

1.2.1 Background, epidemiology and definitions

As a topic of research, child homicide has only fairly recently received attention. Yet, the practice of killing children dates back in history and has at times been a socially accepted way of ensuring the lives of fit family members at the expense of less healthy ones (Hatters Friedman, Cavney, & Resnick, 2012; Koenen et al., 2008; Sharma, 2006; West, 2007). Even today, political means of population control, e.g., the one-child policy of China, are believed to spur the killing of children – mainly females, since, in the societies in question, they impose much more of a financial and cultural burden on their families than their male counterparts (Koenen et al., 2008). Globally, the rate of homicides involving victims under the age of 15 years is estimated to be 2 per 100 000 inhabitants, with marked differences across the globe (see Figure 2) (United Nations Office on Drugs and Crime, 2014). In Europe, however, the rates are lower – about 0.5 per 100 000 inhabitants – in the wake of a substantial decline across many countries on the continent during the past few decades (Ellonen, Kääriäinen, Lehti, & Aaltonen, 2015; Lehti, Kääriäinen, & Kivivuori, 2012; Sturup & Granath, 2015). The mechanisms underlying the decline remain largely obscure; nevertheless, improved living standards, control of human reproduction, changes in routine activities and decreased stigmatization of single-parent households are all factors that are be-

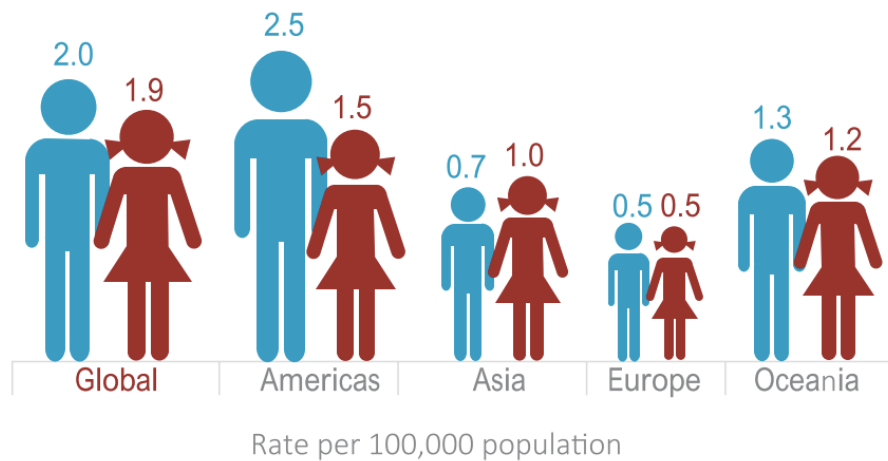


Figure 2. Child homicide rates per 100 000 inhabitants across different continents. The data are based on the United Nations Office of Drugs and Crime Homicide Statistics 2013, which are accessible at <https://www.unodc.org/gsh/en/data.html>. The figure is reprinted from the same organization’s publication “Global Study on Homicide 2013”.

lieved to have contributed (Ellonen et al., 2015; Lehti et al., 2012). It may be noted, however, that the legalization of abortion in the U.S. has not been clearly linked to decreased rates of homicide in young children (Sorenson, Wiebe, & Berk, 2002). In Sweden, it has been shown that the decline in child homicides mainly has been driven by a drop in cases of filicide–suicide, i.e., the parental killing of a child (filicide) followed by offender suicide (Sturup & Granath, 2015). Interestingly, although the actual killing of children is a rare event, the occurrence of filicidal thoughts have been reported in almost one out of four mothers to colicky infants during episodes of screaming (Levitzky & Cooper, 2000). In a more recent study from Taiwan, filicidal–suicidal ideation was uncovered in nearly 15% of parents to school-aged children over the course of a year (Wei & Chen, 2014). Moreover, in a study focusing on spatial clustering in child homicide, the authors showed that such events could be predicted by lower median household income and larger number of single-parent households (Shenoi et al., 2013). Since a large number of child homicides had occurred in small areas, the authors advocated that targeted and cost-effective interventions should be concentrated to such small areas (Shenoi et al., 2013). In a recent American study, victims of child homicide were found to have used emergency medical services to a greater extent than children who had died of natural causes; unfortunately, as the authors point out, the nature of the medical complaints that called for paramedics’ assistance was not helpful in detecting child maltreatment (Shenoi, Nassif, Camp, & Pereira, 2017).

Child homicide is commonly subdivided into intra-familial and extra-familial cases, most often with the former clearly predominant (Cavanagh, Dobash, & Dobash, 2005; Laursen et al., 2011; Somander & Rammer, 1991; Sturup & Granath, 2015). The intra-familial group is almost entirely comprised of filicides, although homicides committed by relatives other than parents sometimes occur (Somander & Rammer, 1991; Stöckl, Dekel, Morris-Gehring, Watts, & Abrahams, 2017). Almost half a century ago, American psychiatrist Phillip Resnick

(1969) formulated a typology of filicide to facilitate further understanding of the phenomenon. His paper is still widely cited, and although several scholars have proposed new typologies, none of these has reached widespread use (see, for example, references [Biron & Reynald, 2015; Mugavin, 2005; Putkonen et al., 2016]). Five categories were identified by Resnick: (i) the altruistic filicide, which is characterized by the urge to relieve (real or imagined) suffering; (ii) the acutely psychotic filicide, in which the offender is acting under the influence of psychosis; (iii) the unwanted child filicide, in which the offender primarily strives to rid him- or herself of the child; (iv) the accidental filicide, which is characterized by the unintentional use of excessive violence by a battering parent; and last, (v) the spouse-revenge filicide, in which the offender kills primarily to retaliate against a former or current intimate partner (Resnick, 1969). Further, the terms neonaticide and infanticide are frequently used to describe subcategories of filicides that take place during the first 24 hours of life or during the first year, respectively (Resnick, 1969, 1970; West, 2007). The term familicide is vaguely defined; in its broadest definition, it is used to describe the killing of multiple family members. In a narrower definition, employed by Liem and co-workers (2013), familicide denotes the killing of an intimate partner and at least one child. In the majority of the latter events, perpetrators were found to have committed suicide in conjunction with the fatal event (Liem, Levin, Holland, & Fox, 2013). Some additional comments regarding familicide are given below.

1.2.2 Common methodological challenges in child-homicide research

International child-homicide research is plagued by a number of drawbacks that need to be acknowledged. First, there is a lack of uniform definitions of key variables, which makes cross-national comparisons difficult (Stöckl et al., 2017). For example, the definition of what constitutes a child varies considerably, as does the stipulated time interval between filicide and parental suicide in filicide–suicide cases. Second, many studies have used small samples drawn from inherently biased populations, such as forensic-psychiatric wards or correctional facilities. Third, a major problem in many studies is the exclusion of filicide–suicide offenders, who constitute a substantial proportion of all filicide offenders and are predominantly male (Flynn, Shaw, & Abel, 2013; Hatters Friedman, Hrouda, Holden, Noffsinger, & Resnick, 2005; Marzuk, Tardiff, & Hirsch, 1992; Nordlund & Temrin, 2007; Somander & Rammer, 1991; Sturup & Granath, 2014). Fourth, some studies raise validity concerns owing to the use of sources containing data from individuals who, at inclusion, had merely been arrested under the suspicion of having committed child homicide (see, for example, [Eke, Basoglu, Bakar, & Oral, 2015; Mariano, Chan, & Myers, 2014]). Finally, a number of prior attempts have been made to classify child homicide into meaningful categories in order to facilitate preventive action; unfortunately, the usefulness of many proposed typologies is limited by a considerable overlap between categories (Putkonen et al., 2016; Silva et al., 1998).

1.2.3 Mental disorders in child-homicide offenders

Given the gruesome nature of child homicide, laymen are likely to assume that offenders suffer from a severe mental disorder. Indeed, several studies have shown psychiatric morbidity in almost half of filicide offenders, with elevated rates of affective disorders, personality disorders and psychotic states (Flynn et al., 2013; Flynn, Shaw, & Abel, 2007; Putkonen, Amon, et al., 2009). One of the most recent studies found that evidence of a mental disorder had been uncovered in 40% of filicide offenders (Flynn et al., 2013). However, inter-study comparisons are less meaningful on account of methodological disparities, as discussed previously. Markedly elevated rates of unnatural deaths – especially with respect to homicide victimization – have been reported in children whose mother or father suffers from mental illness (Chen, Chiou, Tang, & Lin, 2010; Webb, Pickles, Appleby, Mortensen, & Abel, 2007). Further, in a Danish cohort study, an almost 9-fold increase in the risk of becoming a filicide victim was found among children whose parents had been subjected to psychiatric inpatient care, although the absolute risk increase was small (Laursen et al., 2011). Moreover, a Swedish matched cohort study found major psychiatric disorder – defined as either affective disorder, psychotic disorder or personality disorder – and prior suicide attempts to be independent risk factors for filicide (Lysell, Runeson, Lichtenstein, & Långström, 2014). However, a Finnish case-control study, which did not include filicide-suicide cases, concluded that filicide offenders were not more mentally disordered than other homicide offenders (Putkonen, Weizmann-Henelius, Lindberg, Eronen, & Häkkänen, 2009). Among factors related to the victim, multiple birth has been identified as an independent risk factor for filicide, possibly by way of increasing strain in already vulnerable parents (Lysell et al., 2014). That finding, however, must be interpreted with caution since very few such cases were included in the sample.

Post-partum psychosis, or “puerperal insanity” as it traditionally has been called, is a state of severe mental disturbance that occurs at a rate of about 1 or 2 in 1000 deliveries (Jones, Chandra, Dazzan, & Howard, 2014) and typically develops during the first weeks post partum (Friedman et al., 2012; Jones et al., 2014). The disorder is characterized by its dramatic, delirium-like symptomatology, which includes disorganization, depersonalization, derealization and sometimes delusions of altruistic homicide (Bergink, Rasgon, & Wisner, 2016). In 1922, the *British Infanticide Act* was implemented to ensure less harsh sentences for women who had killed their children (during their first year of life) while not “having fully recovered from the effect of giving birth to a child” (Hatters Friedman & Resnick, 2007; Oberman, 1996). Sweden and several other countries have passed similar laws that are still in effect, although highly debated on account of gender-specific judicial inequalities and a lack of biological support for the seemingly arbitrary one-year cutoff (Hatters Friedman et al., 2012). It is worth noting that the United States is an outlier in this respect, since all of the country’s 50 states lack infanticide statutes and, accordingly, classify all killings of infants as some degree of homicide (Malmquist, 2013).

1.2.4 Neonaticide

Neonaticide cases are commonly studied separately, since they – compared to infanticides and other filicides – differ with regard both to perpetrator and offense characteristics (Camperio Ciani & Fontanesi, 2012). In a typical case, the offender is a young woman of low socio-economic status; she is unmarried and unemployed, lives with her parents and has eschewed contact with prenatal care (Hatters Friedman, Horwitz, & Resnick, 2005). Moreover, she usually has no psychiatric illness, although she may lead a passive and sometimes isolated life, and many times denies or attempts to conceal the pregnancy (Amon et al., 2012; Hatters Friedman, Horwitz, et al., 2005; Porter & Gavin, 2010; Putkonen, Weizmann-Henelius, Collander, Santtila, & Eronen, 2007). The neonaticidal mother usually gives birth alone in her home; she performs the killing alone and thereafter takes measures to hide the crime. Such incidents are not associated with offender suicide (Camperio Ciani & Fontanesi, 2012; Hatters Friedman & Resnick, 2009), and with respect to Resnick's typology, the unwanted child category is highly, albeit not exclusively, applicable (Resnick, 1969, 1970). In a systematic review that included ten studies on neonaticide, the authors noted a slight change in the characteristics of neonaticidal women during the last few decades, in that an increasing proportion of married, multiparous and mentally disordered offenders was observed (Tanaka et al., 2017). The isolated circumstances that characterize the deaths of many neonaticide victims have led to the belief that neonaticides likely account for a substantial portion of the so-called dark figure of child homicide (Brookman & Nolan, 2006; Frederick, Goddard, & Oxley, 2013). Indeed, a Norwegian article supports that belief, since the author was not able to identify a single neonaticide case in Norway (a country with nearly 5 million inhabitants) during the years 1990 to 2009 (Ottesen, 2012).

From a preventive point of view, neonaticide has received substantial attention (Hatters Friedman & Resnick, 2009). Starting in France as early as the 18th century, many countries have enacted laws that give women the possibility of delivering babies anonymously at hospitals (Tanaka et al., 2017). Interestingly, in Austria, the implementation of such laws has been shown to be associated with a significant decrease in the number of neonaticide cases (Grylli et al., 2016; Klier et al., 2013). By the early 2000s, so-called safe-haven laws had been passed in at least 45 states in the U.S. (Hatters Friedman & Resnick, 2009), and the authorities had established numerous locations where newborns could be turned in anonymously and become wards of the state. Also, in several countries, so-called baby hatches – i.e., small boxes in which newborns can be left anonymously by their parents – are in use (Klier et al., 2013). Such boxes are usually placed close to a police station, a hospital or a fire station, and when a baby is placed inside one of them, an alarm is set off to make sure the baby is tended to immediately. In a typical case, the baby is soon thereafter prepared for adoption. The introduction of baby hatches has brought about an ethical debate in many countries – not least in Japan, where skeptics of such measures have raised concerns that baby hatches may be a way for individuals to evade parental responsibility (Asai & Ishimoto, 2013).

1.2.5 Maternal versus paternal filicide

Traditionally, the literature on filicide has been dominated by studies focusing on maternal rather than paternal offenders (Bourget, Grace, & Whitehurst, 2007). Although results are somewhat contradictory, studies have found that mothers and fathers are equally likely to commit filicide – thus making it one of the few violent crimes that are not predominantly perpetrated by males (Bourget & Gagne, 2002; Bourget & Gagné, 2005). At the same time, it has been shown that female offenders – as opposed to their male counterparts – are likely to kill younger victims (Bourget et al., 2007; Kauppi, Kumpulainen, Karkola, Vanamo, & Merikanto, 2010), a finding consistent with the notion that fathers are less commonly engaged in the lives of younger children. With regard to methods of violence, mothers more often use less brutal methods, such as drowning or strangulation, whereas fathers, to a greater extent, show excessive brutality by shooting the child or banging the child's head against a hard object (Kauppi et al., 2010). Interestingly, a Finnish study has found that male perpetrators were less likely than their female counterparts to be deemed not guilty by reason of insanity during the judicial process (Kauppi et al., 2010). Indeed, as the authors note, because males are stereotypically regarded as being more violent than females, males may be less often required to undergo a forensic-psychiatric evaluation.

1.2.6 Filicide–suicide and familicide

It has been proposed that psychotic offenders and offenders acting altruistically may experience a relief of tension after having committed a filicide and therefore abandon their initial plan of also committing suicide (Resnick, 1969). Other offenders, who have not planned a subsequent suicide, may, nevertheless, faced with the gravity of their deed, choose to take their own lives (Resnick, 1969). Filicidal-suicidal fathers are, on average, older than mothers who commit filicide–suicide, and findings indicate that more than 75% of filicide–suicide offenders show signs of mental illness, most often psychosis or depression (Hatters Friedman, Hrouda, et al., 2005). Using a large U.S. database, Shackelford and co-workers (2005) tested several hypotheses regarding filicide–suicide events. They found that multiple-victim filicides were more likely to culminate in offender suicide than single-victim cases. Further, their results pointed to a heightened risk of suicidal outcome in cases with older children and in cases with male offenders (Shackelford et al., 2005). The same research group has investigated historical filicide–suicide cases and found similar results, indicating that filicide–suicide is a phenotypically stable phenomenon (Shackelford, Weekes-Shackelford, & Beasley, 2008).

A related but rarer event, familicide, occurs about 20 times annually across the U.S. (Liem et al., 2013). Studies have found similarities between, on the one hand, perpetrators of intimate-partner homicide and, on the other hand, perpetrators of filicide or familicide (Liem & Koenraadt, 2008). However, according to a Dutch study, individuals in the latter groups more often lack prior convictions for violent offenses, which indicates that reliance on criminal records alone is insufficient for adequate violence-risk appraisals in these special cases (Liem & Koenraadt, 2008). By contrast, in a recent review on the topic of familicide in the Western

world, the authors found prior convictions and violent behavior to be prevalent across different categories of familicide offenders (Aho, Remahl, & Paavilainen, 2017). In addition, the authors noted that many familicide offenders had both displayed psychological instability and many times sought help for mental-health problems prior to the fatal event – important findings in the context of prevention (Aho et al., 2017). Further, personality disorders have been shown to be prevalent among familicide offenders (Liem & Koenraadt, 2008), but no clear association has been established with financial downturn, which has been hypothesized to precipitate such events (Liem et al., 2013).

1.2.7 An evolutionary perspective on filicide

Daly and Wilson (1988, 1994) have published seminal papers with an evolutionary perspective on child maltreatment and child homicide. Simply put, they argue that violent acts against genetic offspring are hard to explain within a Darwinian framework, according to which life's main objective is transgenerational survival of one's own genetic material; in such a framework, solicitude toward one's own progeny would be expected. Consequently, Daly and Wilson hypothesized that stepparental violence should be more common than violence committed by genetic parents; the authors were later able to confirm their hypothesis (Daly & Wilson, 1994), and the finding was replicated in Canadian (Dawson, 2015; Harris, Hilton, Rice, & Eke, 2007) and U.S. (Weekes-Shackelford & Shackelford, 2004) datasets, yet not in two studies from Sweden (Temrin, Buchmayer, & Enquist, 2000; Temrin, Nordlund, & Sterner, 2004) or a study based on U.S. pre-trial filicide arrests (Mariano et al., 2014). Moreover, it has been shown that stepparents, to a greater extent than genetic parents, kill by means of brutal violence (Daly & Wilson, 1994; Harris et al., 2007; Weekes-Shackelford & Shackelford, 2004). This disparity has been associated with differing motivational factors among perpetrators, whereby biological parents more often kill for altruistic reasons by means of relatively gentle violence, e.g., smothering or drowning (Harris et al., 2007). Stepparental violence, on the other hand, is believed to stem from conflicts and possibly bitterness and resentment, thereby making violent methods, such as beating, more common (Harris et al., 2007).

At the same time, Harris and co-workers (2007) have proposed that neonaticidal incidents are compatible with an evolutionary framework: although the mothers typically are socio-economically underprivileged, they are also often young and mentally sound, thus possessing considerable residual reproductive fitness. By killing their neonate, they can focus on tending to older children and creating for themselves a Darwinistically more favorable situation for subsequent pregnancies (Harris et al., 2007). Even the neonaticide offenders' predilection for hiding their crime fits this model, in that evading detection favors future reproduction. The risk of becoming a victim of homicide is greatest during the first day of life (Hatters Friedman et al., 2012) – a finding that also fits evolutionary theory, which states that a child's reproductive value increases over time (Camperio Ciani & Fontanesi, 2012). It is worth noting that older female filicide offenders rarely fit the same pattern; compared to their younger counterparts, these women have markedly less reproductive potential, and they more

frequently suffer from mental disorders and also more often commit post-offense suicide (Bourget et al., 2007; Daly & Wilson, 1988; Harris et al., 2007). In a broader perspective, Nordlund and Temrin (2007) concluded that evolutionary models do not sufficiently explain the heterogeneous phenomenon of child homicide.

1.3 ADHERENCE

The third study in the present thesis deals with homicide offenders' and victims' adherence to psychotropic medications. Suboptimal adherence to treatment is a major global-health concern, in that it incurs negative effects both from the perspective of non-adherent patients' quality of life and from the perspective of health economics, as highlighted in a report from the World Health Organization (2003). In that report, it is stated that adherence to long-term treatment for chronic illnesses averages a modest 50% in developed countries; the rate of adherence can be assumed to be even lower in developing countries (World Health Organization, 2003). Further, the WHO advocates a multidisciplinary approach to increase adherence rates, since the concept of adherence is multifaceted and includes patient-related, disease-related, economic and social factors (World Health Organization, 2003). Because assessing adherence is a central aspect in the field of pharmacoepidemiology, some basic remarks on the topic are given in the following sections. However, the interested reader should turn to the scientific literature for a more complete overview of the field.

1.3.1 Defining adherence

In everyday healthcare practice, the terms *adherence* and *compliance* are frequently used interchangeably – in most cases, probably, without giving rise to problematic misunderstandings. Yet, as the WHO points out, *compliance* has negative connotations (it is said to entail blame or patient passivity) and should preferably be avoided in favor of the more neutral word *adherence* (World Health Organization, 2003). Thus, in accordance with a fairly recent article in this field (Lam & Fresco, 2015), the term adherence will be used consistently throughout the thesis frame. The WHO has defined adherence as “the extent to which a person’s behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider” (World Health Organization, 2003). To further complicate the matter, the term *concordance* is sometimes used (mostly in the nursing literature), whereby the dynamics of the interaction between a healthcare provider and a patient – rather than actual medication-taking behavior – is recognized (Lehane & McCarthy, 2009). Moreover, the terms *primary* non-adherence and *secondary* non-adherence are sometimes used. Primary non-adherence denotes a situation in which a patient fails to get his or her prescription filled, whereas secondary non-adherence denotes a situation in which a patient gets a prescription filled yet fails to take the medication (Lam & Fresco, 2015).

1.3.2 Measuring adherence

There are numerous ways of measuring adherence to pharmacotherapy. However, as pointed out by Lam and Fresco (2015) in their review article, none of the available methods can be

considered as a gold standard; instead, for optimal reliability, a combination of methods is recommended. A Swiss study, in which adherence to antidepressants was assessed with the aid of toxicological analyses as well as patients' reports of medication use and doctors' assessments of medication use in each patient, may serve as an example of a combined methodology (Loayza, Crettol, Riquier, & Eap, 2012). By contrast, a study by Roberson and co-authors (2016), who compared electronic prescriptions for antidepressants with toxicological analyses of discarded routine blood samples, is an example of a single-method approach.

So-called *direct* measures (sometimes referred to as *objective* measures) involve biochemical confirmation or observed medication taking, whereas *indirect* measures (sometimes referred to as *subjective* measures) rely on methods that include self-reported medication-taking behavior, pill count or dispensed prescriptions (Lam & Fresco, 2015). In their review on methods of assessing adherence to oral antipsychotics, Velligan and co-workers (2005) noted that the majority of previous studies were based on indirect measures. One of the problems of such measures can be illustrated with the following question, which was raised by a number of their study subjects: "How do you expect me to remember when I forget to take my medication?" (Velligan et al., 2005). Undoubtedly, another potential problem is the possibility that patients knowingly withhold information about suboptimal adherence to their healthcare providers.

To most people, toxicology-based methods would probably stand out as intuitively appealing. However, one should be aware that such methods also have a number of drawbacks: first, they can only uncover medication-taking behavior during a short period of time preceding specimen sampling; second, they can rarely provide information regarding whether the exact prescribed dose of any medication has been ingested; and third, they can never reveal whether the analyzed individual has abstained from taking non-prescribed medications not included in the assay (Lam & Fresco, 2015). Further, some medications might only be toxicologically detectable at elevated concentrations following intake of excess amounts; consequently, an individual who is adherent to such a medication would appear non-adherent.

A wide range of methods have been proposed to assess adherence based on prescription data, one of which – PRE2DUP – adds increasing sophistication to the assessment by taking into account stockpiling, personal purchase patterns and hospital stays (Tanskanen et al., 2015). A simpler and perhaps more commonly used parameter, the medication possession ratio (often referred to as MPR), is calculated by dividing the number of days for which medication has been supplied within a refill interval with the total number of days within that same interval (Hess, Raebel, Conner, & Malone, 2006). However, information regarding patients' individual adherence trajectories may be overlooked with such a simple methodology, as highlighted in recent research (MacEwan et al., 2016).

In general, any inpatient care is potentially problematic from the viewpoint of assessing prescription-based adherence since inpatients' medications usually are provided by other routes than prescriptions. Hence, estimates of adherence are likely to be somewhat biased in

cases in which the patient has received inpatient care during the study period. However, with regard to the content of the present thesis, it should be noted that virtually all medications distributed within the Swedish Prison and Probation Service (i.e., in correctional facilities and remand prisons throughout Sweden) are issued by means of ordinary prescriptions.

1.4 TOXICOLOGY

1.4.1 Definition and basic principles

Forensic toxicology provides the basis for the first three of the studies included in the present thesis, and therefore warrants some attention. It should be noted that even though the techniques used for quantitation are quite accurate, forensic toxicology is not to be regarded an exact science, since all laboratory results ultimately are dependent upon the experience and interpretative skill of the forensic toxicologist (Mozayani & Noziglia, 2011). On its website (www.abft.org), the American Board of Forensic Toxicology gives the following definition of the field:

Forensic toxicology encompasses the measurement of alcohol, drugs and other toxic substances in biological specimens and interpretation of such results in a medicolegal context.

When interpreting toxicological results, one should be aware that a number of circumstances may introduce error: for instance, the collection, transportation and storing of biological material; the time interval between death and the finding of the victim; as well as the preparation of specimens, including their freezing, thawing and aliquoting (Dinis-Oliveira et al., 2010). In addition, the multitude of involved experts – e.g., physicians, the police and the autopsy personnel – and the collaboration between these experts, may introduce error (Dinis-Oliveira et al., 2010). Also, as indicated above, it should be borne in mind that forensic toxicology can only provide a snapshot of what substances were present in a body at the time of sampling; hence, information regarding routes of ingestion and exact doses of the ingested substances cannot be deduced (Mozayani & Noziglia, 2011).

Although forensic-toxicological analyses can be conducted using several different tissues, it has been suggested that relevant *quantitative* analyses can only be performed using plasma, serum or blood (Dinis-Oliveira, Vieira, & Magalhães, 2016). Upon death, multiple factors contribute to changes in the concentrations of substances in the body by way of a process known as *post-mortem redistribution* (Han et al., 2012; Yarema & Becker, 2005). Such factors include cell death, putrefaction, diffusion from stomach to nearby organs, biochemical drug characteristics and body position and movement after death (Yarema & Becker, 2005). For example, in a dead body, blood tends to pool due to the effect of gravity, and if such pooling occurs close to an organ in which drugs are present in high concentrations (such as the liver), diffusion of drug molecules to blood nearby may occur (Mozayani & Noziglia, 2011). A key mechanism in the process of post-mortem redistribution is the post-mortal loss of cell structure and cell integrity. Blood samples from ligated peripheral vessels (such as the femoral artery or vein) are best suited for analysis, since these vessels are located far from the

abdominal and thoracic organs, in whose proximity post-mortem redistribution may distort the concentrations of the substances of interest (Dinis-Oliveira et al., 2016; Mozayani & Noziglia, 2011). Even in cardiac blood, which is easily accessible and commonly used in forensic toxicology, the effects of post-mortem redistribution have been shown to cause up to 10-fold changes in concentration (Drummer & Gerostamoulos, 2002). When no blood specimen is available, for instance due to severe blood loss (so-called exsanguination) or burning of the body, vitreous humor (the gel-like substance that fills the eye) is well suited for analysis (Bévalot, Cartiser, Bottinelli, Fanton, & Guitton, 2016).

1.4.2 Forensic-toxicological aspects of alcohol

Alcohol is the most frequently used psychoactive substance and also the most commonly detected substance in post-mortem toxicology (Kugelberg & Jones, 2007); as such, it deserves special attention. When ingested, the ethanol molecule is readily absorbed from the mucosa of the stomach and small intestine (A. W. Jones, 2016). The blood-alcohol concentration has been shown to increase more rapidly following ingestion of drinks with a high alcohol content compared to ingestion of drinks containing less alcohol (A. W. Jones, 2016). Moreover, the absorptive phase is highly dependent upon a number of factors including the speed of gastric emptying and whether the subject recently has eaten (A. W. Jones, 2016).

The *Mellanby effect*, i.e., the subjective sensation of a lesser degree of inebriation during the descending limb of the blood-alcohol curve compared to corresponding sensation on the ascending limb, has been recognized for more than half a century (Holland & Ferner, 2017). The phenomenon is believed to reflect an acute tolerance for ethanol, although the underlying mechanisms remain unclear (Holland & Ferner, 2017). Theoretically, the Mellanby effect may be of importance with regard to the propensity of intoxicated individuals – at different points along the blood-alcohol curve – to engage in violent acts or to defend themselves against violence. However, a review article has found mixed support for the existence of an acute tolerance for ethanol; in the studies included in the article, subjects felt less inebriated during the descending limb of the blood-alcohol curve compared to the ascending one, yet results from objective measures of impairment were found to be worse during the phase of declining alcohol concentration (Holland & Ferner, 2017).

Small amounts of ethanol can be synthesized post mortem by the action of molds, bacteria and yeast (Boumba et al., 2012; O’Neal & Poklis, 1996); however, speedy recovery of the body followed by proper refrigeration can prevent such synthesis and thus minimize the risk of misleading forensic-toxicological results (Kugelberg & Jones, 2007). Unfortunately, it is not possible to delineate a firm cut-off, with regard to blood-alcohol concentration, above which the possibility of post-mortem ethanol formation can be excluded (O’Neal & Poklis, 1996); instead, scholars have advocated the use of certain ethanol metabolites (ethyl sulfate and ethyl glucuronide) to help distinguish between ante-mortem ingestion and post-mortem formation of ethanol (Krabseth, Mörlund, & Höiseth, 2014).

1.4.3 Methods used for forensic-toxicological analysis

The beginning of the twentieth century saw the advent of chromatographic techniques, by way of which molecules can be separated according to their differential propensities to migrate in a medium (Mbughuni, Jannetto, & Langman, 2016). At about the turn of the half-century, mass spectrometers had been developed, and both of these techniques – chromatography and mass spectrometry – have up until today become increasingly sophisticated (Mbughuni et al., 2016). The combination of these two methods (e.g., gas chromatography–mass spectrometry, GC–MS) is widely used for forensic-toxicological analyses of a range of prescription medications and narcotics (see Figure 3 for a schematic presentation of a typical GC–MS apparatus) (Mbughuni et al., 2016). Briefly, GC–MS operates in the following sequence: first, molecules in the gaseous phase are separated according to different retention times in the GC column; second, when passing into the MS section of the combined instrument, the molecules are ionized (e.g., by being bombarded with electrons), allowing them subsequently to be identified on the basis of their charge-to-mass ratio (Mbughuni et al., 2016).

Analysis of ethanol in blood is commonly performed using a somewhat different method: headspace gas chromatography, most often abbreviated HS–GC (Jones & Fransson, 2003). In short, the “headspace” of HS–GC refers to the process by which a volatile substance (e.g., ethanol) establishes equilibrium between its vapor and liquid phases in a closed container (e.g., a glass vial). For analytical purposes, the vapor phase is used. Having constructed a calibration curve, and taking into account the fact that the ratio of the concentrations in the liquid and vapor phases is constant, one can fairly simply calculate the concentration of the substance of interest in the liquid phase of the sample (Jones & Fransson, 2003). Moreover, analyses of ethanol for legal purposes are always conducted in duplicate (A. W. Jones, 2016).

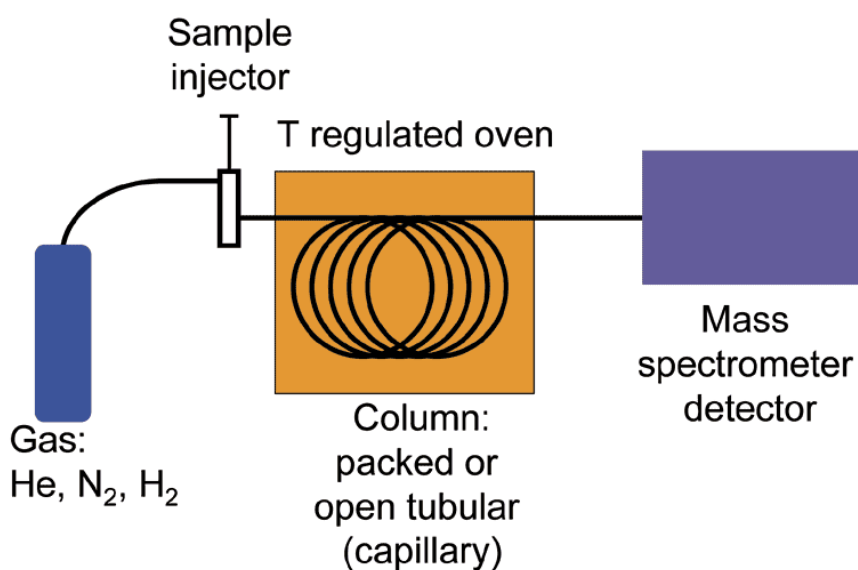


Figure 3. A schematic presentation of a GC–MS apparatus. Reprinted from Wikipedia.org.

2 AIMS AND HYPOTHESES

No over-arching aims were formulated at the outset of this doctoral project. However, the different studies included all have specified aims, as described in the following sections.

2.1 STUDY I

In this study, we aimed to examine the prevalence of licit and illicit psychoactive substances among perpetrators and victims of homicide in Sweden, and to describe positive toxicological tests with respect to time and location of the offense. A further aim was to investigate whether analyses of unsolved cases and cases of homicide–suicide would yield diverging results.

2.2 STUDY II

In the second study, using a case-control design, the objective was to investigate to what extent the presence of ethanol would increase the risk of involvement in homicide. We used controls who had suffered vehicle-associated deaths, assuming that such subjects would reflect conditions in a general-population sample of ambulant community-dwelling adults. We hypothesized that ethanol would increase the risk of involvement in homicide.

2.3 STUDY III

In the third study, also using a case-control design with vehicle-accident controls, we aimed to assess the extent to which adherence to, and recreational use of, psychotropic medications would influence the risk of homicide offending and victimization. On the basis of prior research, we hypothesized that homicide offenders and victims, compared to vehicle-accident controls, would be less adherent with regard to medications used to treat affective and psychotic disorders; yet more prone to engage in recreational use of addictive medications used to treat anxiety and sleep disorders.

2.4 STUDY IV

The fourth study aimed at examining a wide range of characteristics in cases of intra- and extra-familial child homicide. In addition, we set out to investigate changes in the rate of child homicides during the years 1992 to 2012. First, we hypothesized that there had been a decline in the rate of child homicides between those years; second, we hypothesized that there had been a drop specifically with regard to depressive filicide offenders, as measured by a depressive-offender proxy.

2.5 STUDY V

In the fifth study, using a case-control design with matched general-population controls, we set out to explore potential risk factors associated with filicide victims by investigating whether previous healthcare use for injury or intoxication would influence the risk of filicide victimization. Specifically, we hypothesized that prior healthcare use for treatment of these conditions would increase the risk of filicide victimization.

3 MATERIAL AND METHODS

3.1 DEFINITIONS

3.1.1 Homicide and homicide–suicide

The definition of homicide was briefly touched upon in the first part of the thesis introduction. In all of the included studies, we have employed a uniform definition, which is in line with the one used in the multinational collaborative effort on homicide research, the European Homicide Monitor (Liem et al., 2012). Thus, we have included incidents that, according to the Swedish Penal Code (1962), were adjudged to constitute either murder, infanticide, voluntary manslaughter or involuntary manslaughter by means of assault. The definition of homicide employed by the Centers for Disease Control and Prevention (CDC) has, in part, been followed in the present thesis (Centers for Disease Control and Prevention., 2015). The CDC states the following:

Homicide is defined as a death resulting from the intentional use of force or power, threatened or actual, against another person, group, or community. A preponderance of evidence must indicate that the use of force was intentional.

Importantly, as stated by the CDC, and in line with our definition of homicide, attempted homicides and hunting accidents, as well as deaths that take place in combat in declared or undeclared war, are not included. Also, so-called “vehicular homicide” (e.g., due to drunken driving), without evidence of intent to use force against the victim, is excluded.

As mentioned previously, homicide followed by the suicide of the perpetrator (i.e., homicide–suicide) is a well-acknowledged, albeit not distinctly defined, subtype of lethal violence (Liem, 2010). Some authors employ a 24-hour cutoff with regard to the homicide–suicide interval (Liem et al., 2011), whereas others employ a definition that includes any post-homicide suicide prior to conviction (Large et al., 2009a), or even no time limit at all between the homicide and the suicide (Panczak et al., 2013). It can be noted that all suicides committed post homicide in our datasets occurred within minutes or hours of the initial fatal event.

3.1.2 Solved case

Following previous work by Sturup and co-workers (2015), a case is considered solved when the offender is convicted or when other circumstances entail that the police consider it to be solved. For example, the latter situation may arise in cases of homicide–suicide or in cases in which a suspect commits suicide in custody or is killed prior to arrest.

3.1.3 Substance misuse

Despite the lack of a clear definition, the term “substance misuse” is used throughout the thesis frame, as well as in some of the articles included. It should be noted that the term is commonly encountered in the scientific literature, but with varying definitions; for instance,

in one study, “substance misuse” was defined as either substance dependency or abuse (Lysell et al., 2014). In another study, the term was defined as a “conviction for any drug-related crime” or “having had a diagnosis made of an alcohol- or drug-misuse-related disease” (Sariaslan et al., 2013). In the current thesis, I have purposely avoided using terms that are associated with clearly defined disease states featured in the leading diagnostic manuals. Thus, since we have not had access to diagnostic data for the majority of the included subjects, we have tried to avoid using terms such as “substance use disorder”, “abuse” or “dependency”. Instead, by using “substance misuse”, we have given ourselves the opportunity to address problematic substance-related behavior, without falsely giving the appearance of having made well-founded diagnostic assessments. It should be noted that the WHO states the following concerning the term “psychoactive substance misuse” on their website (World Health Organization, 2017):

Use of a substance for a purpose not consistent with legal or medical guidelines, as in the non-medical use of prescription medications. The term is preferred by some to abuse in the belief that it is less judgemental.

3.1.4 Child and parent

For the purpose of the present thesis, a child is defined as an individual who has not reached his or her fifteenth birthday. In the definition of the term parent, we include biological parents, stepparents, foster parents, adoptive parents and other individuals *in loco parentis*.

3.2 DATABASES AND REGISTRIES

In the five studies contained in the thesis, information has been collected from a number of databases and registries. Some of these sources are publicly accessible online or by telephone, whereas others are accessible for use upon special request. The data sources used are briefly described in the following sections and also summarized in Table 1.

3.2.1 The Cause of Death Registry

The Cause of Death Registry is maintained by the Swedish National Board of Health and Welfare and includes information on all deceased individuals who, at the time of death, were residents of Sweden – regardless of whether death occurred within the country or abroad. Stillborn babies are not included. The registry was launched in 1961, and since 2012, it has included information also on non-Swedish residents who have lost their lives in Sweden. Causes of death are registered according to the International Classification of Diseases (ICD); from 1997 onwards – i.e., during most of the time of interest for the current thesis – the tenth revision has been in use (World Health Organization, 1996). Unfortunately, the proportion of deaths for which death certificates have not been submitted has increased from less than 0.01% in 1975 to slightly more than 1% in 2012 (National Board of Health and Welfare [Socialstyrelsen], 2013). However, the amount of missing information regarding child fatalities following violent acts, or regarding cases that have undergone medico-legal autopsy for other reasons, is likely minimal.

Registry/database	Study I	Study II	Study III	Study IV	Study V
Cause of Death Registry		√	√		
Forensic-psychiatric evaluations				√	
National Registry of Criminal Convictions	√	√	√	√	√
National Patient Registry				√	√
Prescribed Drug Registry			√		
RättsBase	√	√	√	√	√
Statistics Sweden and the Total Population Registry				√	√
Swedish Tax Agency				√	
ToxBase	√	√	√		

Table 1. Use of databases and registries, by study, in the present thesis.

3.2.2 Forensic-psychiatric evaluations

In Sweden, criminal courts have the possibility of sending individuals for forensic-psychiatric evaluations (FPEs) upon suspicion that a severe mental disorder may be present. All such evaluations are performed at the Department for Forensic Psychiatry within the National Board of Forensic Medicine (NBFM). For individuals in custody, these FPEs take place in a high-security inpatient setting during a maximum time frame of four weeks. The investigation is presided over by a forensic psychiatrist, who is supported by a team, which in most cases comprises a licensed psychologist and a social worker, as well as a member of the ward staff. Somewhat simplified, the principal purpose of the FPE is to provide the court with

information regarding whether the suspected perpetrator is suffering from a severe mental disorder or not. It is worth noting that an opinion based on the FPE is issued to the court, where it is available for both the defense and the prosecutor, thereby facilitating an impartial judicial process for all suspects with regard to psychiatric expert opinion. In most cases in which a severe mental disorder has been uncovered, suspects are given verdicts of forensic-psychiatric care rather than imprisonment. The Swedish judicial system's way of dealing with mentally disordered offenders is thoroughly described in an almost decade-old article by Svennerlind and co-workers (2010). The interested reader is urged to turn to that article, even though some minor changes in the field have occurred since 2010 (for example, FPEs are now carried out at only two sites in Sweden – Stockholm and Gothenburg – and not three, as stated in the article).

Diagnostic procedures are not the prime focus of the FPE. Still, since many of the suspects are observed in an inpatient setting for several weeks – at times, medication-free – the conditions for making sound diagnostic assessments must be regarded nearly optimal. Also, the team psychologist usually adds to the understanding of each suspect's mental state by investigating his or her cognitive abilities using the *Wechsler Adult Intelligence Scale* (Wechsler, 2008) or – more rarely – *Raven's Progressive Matrices* (Raven, 1998). Further, the psychologist may conduct assessments of the suspect's personality, using either the *Structured Clinical Interview for DSM IV – Axis II Disorders* (First, Gibbon, Spitzer, Williams, & Smith Benjamin, 1997) or the *Minnesota Multiphasic Personality Inventory – 2* (Hathaway & McKinley, 2000). Another circumstance that facilitates diagnostic procedures is the possibility of retrieving medical files, as well as files from other authorities, without restrictions imposed for reasons of confidentiality.

During the period of relevance to the present thesis, the forensic-psychiatric evaluations were stored electronically in the NBFM in-house database PsykBase and also kept in an actual archive in Uppsala. The majority of FPEs included in study IV were retrieved from PsykBase; however, some of the earliest documents had to be retrieved from the central archive.

3.2.3 The National Registry of Criminal Convictions

The National Registry of Criminal Convictions (NRCC) is maintained by the National Council for Crime Prevention, which is a governmental authority. It includes information on all verdicts handed down in Sweden since 1973 for individuals who had reached the age of criminal responsibility (15 years) at the time of the offense. Of note, the registry does not include information regarding perpetrators who were acquitted in a district court but later found guilty in an appellate court. Conversely, individuals who were found guilty in a district court, but later acquitted in an appellate court, are nevertheless included. It should be noted, that for the purpose of the studies included in the thesis, data from the NRCC were combined with verdicts retrieved from different courts of appeal or the supreme court, where applicable. In addition to custodial sentences, the registry also contains information on non-custodial sanctions, for instance, suspended sentences, probation and waivers from prosecution. In

Sweden, a plea of not guilty by reason of insanity is not permissible (Radovic, Meynen, & Bennet, 2015); hence, even severely mentally disordered offenders will be given a verdict, provided that they have been found guilty of having committed an offense.

3.2.4 The National Patient Registry

The National Patient Registry (NPR) is maintained by the National Board of Health and Welfare and includes individual-level data regarding all inpatient care provided in Sweden since 1964 (with complete national coverage since 1987) (Ludvigsson et al., 2011). Reporting to the registry is mandatory according to the Swedish law (National Board of Health and Welfare [Socialstyrelsen], 2009). Psychiatric diagnoses have been included since 1973, and overall, the proportion of valid inpatient diagnoses in the NPR – regardless of category – has been shown to range from about 85% to 95% (Ludvigsson et al., 2011). It should be noted that the positive predictive values of diagnoses assigned after hospital admissions due to “trauma and fractures” were found to be 95% or above when compared with medical records (Ludvigsson et al., 2011). Moreover, the proportion of incorrect diagnoses in the registry has been shown to be slightly lower for younger patients than older ones (National Board of Health and Welfare [Socialstyrelsen], 2009).

In a study that compared inpatient diagnoses pertaining to injuries in the NPR with data from ambulance charts (Backe & Andersson, 2008), the authors noted variable agreement between the two sources of data. High agreement was found with regard to fall accidents, whereas lower agreement was found for traffic accidents; indeed, as the authors note, the physicians’ propensity to admit patients, as well as the severity of the medical complaints, is likely to influence such analyses. Over the years, additional variables have been included in the NPR, such as (from 2001 onwards) information regarding visits to specialized outpatient facilities. However, the registry does not contain information on visits in primary care or information regarding outpatient visits to personnel other than physicians (such as nurses, social workers or psychologists) in specialized healthcare facilities.

3.2.5 The Prescribed Drug Registry

The Prescribed Drug Registry is maintained by the Swedish National Board of Health and Welfare and includes individual-level information on all dispensed prescriptions in the country since July 1, 2005 (Wettermark et al., 2007). It is worth noting that the pharmaceutical market in Sweden was subject to a governmental monopoly until July 1, 2009 (“Medical Products Agency – Sweden”, 2017). At that point – which falls within the time period during which the data used in our third study were generated – privately operated pharmacies were introduced across the country. Importantly, the Prescribed Drug Registry includes data from all pharmacies, both privately operated ones and those run by the government. Also, as stated previously, the registry includes data regarding virtually all medications dispensed in correctional facilities and remand prisons throughout Sweden. It is possible to retrieve a fairly large number of variables from the registry, such as the number of pills dispensed and the strength of each medication. Unfortunately, it has proved difficult to

extract information regarding exactly what dose each subject has been prescribed, since the physicians' written instructions (for example, "one tablet each morning") at times are lacking.

3.2.6 RättsBase

The governmental authority NBFM, which has been mentioned above, is responsible for conducting a range of forensic procedures at the request of the police, prosecutors or the criminal courts. The agency is divided into three main departments: the Department for Forensic Psychiatry (located in Stockholm and Gothenburg), the Department for Forensic Medicine (located in Umeå, Uppsala, Stockholm, Linköping, Gothenburg and Lund) and the Department for Forensic Genetics and Forensic Toxicology (located in Linköping). The starting point for all included studies was the NBFM in-house database RättsBase, which includes results from all medico-legal autopsies, as well as from forensic-medical examinations of living subjects, that have been performed in the country. It should be noted that merely 55% of all unnatural deaths that occurred in Sweden in 2008 were referred for medico-legal autopsy (Pettersson & Eriksson, 2014). However, with regard to unnatural deaths in which a crime such as homicide is suspected, the percentage of referred cases is likely to be much higher.

3.2.7 Statistics Sweden and the Total Population Registry

Statistics Sweden is a governmental authority that has made available online a dataset encompassing rich demographic data, as well as data from various societal sectors, such as healthcare and the labor market. According to its website (www.scb.se), Statistics Sweden is "responsible for developing, producing and dissemin[ating] official statistics and other government statistics as well as coordinat[ing] the system for the official statistics". The Total Population Registry is maintained by Statistics Sweden and is thoroughly described in the context of medical research by Ludvigsson and co-workers (2016). Although not flawless, the registry's coverage may be regarded as very high, and updates are transmitted on a daily basis from the Swedish Tax Agency (Ludvigsson et al., 2016). Nevertheless, over-coverage has been estimated to amount to about 0.5% of the Swedish population, mainly owing to underreported emigration data (Ludvigsson et al., 2016).

3.2.8 The Swedish Tax Agency

Among other things, the Swedish Tax Agency manages civil registration of Swedish citizens. Upon request, the authority provides personal information, for example, regarding citizens' country of origin (which was of interest in study IV).

3.2.9 ToxBase

ToxBase is an NBFM in-house database that includes results from forensic-toxicological analyses performed as part of medico-legal autopsies or forensic-medical examinations of living subjects. Biological specimens are routinely collected during medico-legal autopsy, provided that suitable tissue specimens can be obtained. On rare occasions, toxicological analyses are omitted owing to a lack of adequate biological samples for analysis. For

example, as mentioned in the introductory section, suitable biological tissue can be difficult to retrieve if the body is severely burned, exsanguinated or decomposed, or if it has been immersed in water for a long period of time. Note that the methods employed by the NBFM for forensic-toxicological analyses of psychotropic medications are sufficient for detection of medications at therapeutic levels. During the period of interest for the thesis, analyses were performed in one central laboratory.

3.3 SUBJECTS

3.3.1 Studies I–III

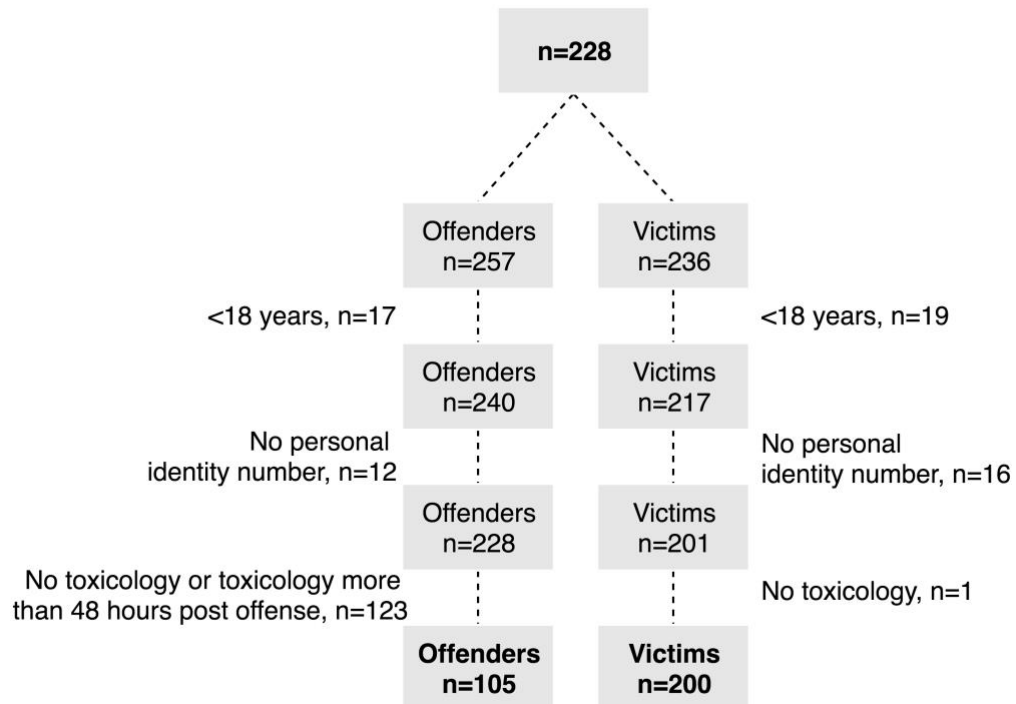
The starting point for the first three studies included in the present thesis was a well-characterized dataset comprising all homicides that occurred in Sweden from January 1, 2007, through December 31, 2009. The dataset includes a total of 264 homicides, 228 of which have been solved, as described in a study by Sturup and co-workers (2015). Victims were identified in the NBFM autopsy registry (RättsBase), which includes the police's identification number (the "k number") for every case. The "k number" was used to collect police reports, whereby it was possible to link a primary offender to his or her victim(s) in each case. In parallel, offenders were identified in the NRCC. The database was expanded by extracting a wide range of information from court verdicts and police reports, for instance, regarding time and type of day of the offense.

In study I, we were able to include a total of 120 homicide offenders and 265 homicide victims; some of the latter were involved in cases that had not been solved at the time of the study. In studies II and III, subjects were limited to 105 offenders and 200 victims, all of whom had been involved in solved cases. The somewhat smaller subset of subjects in those studies was created after exclusion of individuals who were below 18 years of age or who did not have a Swedish personal identity number (without a personal identifier, extraction of data is not possible).

In study II, 1629 control subjects were retrieved using the Cause of Death Registry and ToxBase in the following process: first, individuals who had suffered a vehicle-related death were identified using ICD-9 codes E800–E848 and ICD-10 codes V01–V99 (World Health Organization, 1987, 1996); second, from that initial sample, individuals for whom the forensic pathologist had assigned a code of possible or definite self-inflicted death (ICD-9 codes E950–E959 and E980–E989; and ICD-10 codes X60–X84 and Y10–Y34) were excluded. Finally, individuals who had died in an ambulance or at a hospital, as well as individuals below 18 years of age, were excluded. In the same manner, 1643 individuals were selected as controls to be used in study III. The control population in study II is very similar to the one used in study III, except for the exclusion in the former study of a small number of controls in whom analyses of ethanol were lacking or had been performed using other tissues than blood. It should be noted that a quantitative measure of ethanol was of interest in study II, whereas no quantitative estimates were required regarding the different medicat-

A

All solved homicides in Sweden
January 1, 2007 – December 31, 2009

**B**

Vehicle-accident fatalities
January 1, 2006 – June 30, 2014

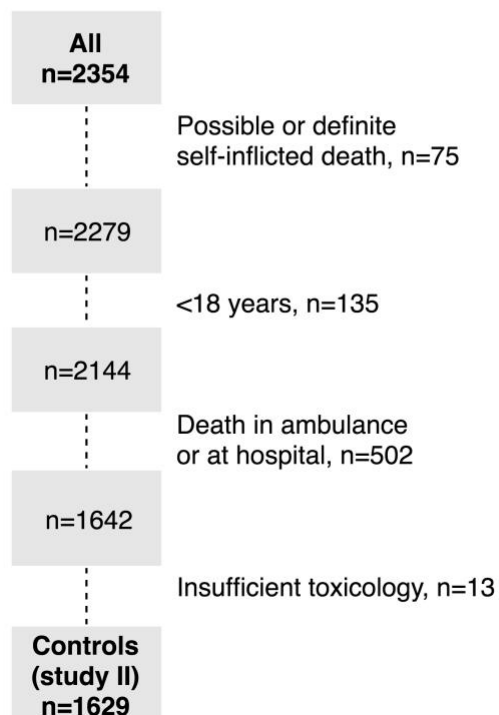


Figure 4. Selection process of subjects in study II (panel **A**: offenders and victims; panel **B**: controls).

ions that were analyzed in study III; the exclusion of a small number of controls is thus motivated by the fact that quantitative measures only can be performed in plasma, serum or blood (Dinis-Oliveira et al., 2016). In studies I–III, for living subjects (i.e., offenders), biological sampling had to have been performed within 48 hours post offense. Figure 4 summarizes the selection process for subjects in study II, and it may be noted that the corresponding process for selection of controls for study III is very similar up until the last step but one (unfortunately, in the published version of study III, the period during which controls were recruited was erroneously stated to be six months shorter than it actually was).

3.3.2 Study IV

Using the NBFM in-house autopsy database (RättsBase), we started out by identifying all individuals who – prior to their fifteenth birthday – had been adjudged to be victims of homicide upon medico-legal autopsy. We included all such deaths that had occurred in Sweden during the period January 1, 1992, to December 31, 2012. Next, we compared the identified cases with the NRCC to ensure that no cases were overlooked or mistakenly included. Indeed, it is possible that the forensic pathologist’s ruling of homicide can be contradicted by a not guilty verdict. Hence, court rulings were collected in non-homicide-suicide cases to make sure that victims in those cases had died as the result of a criminal act. Here, a court ruling of murder, manslaughter, infanticide, voluntary manslaughter or involuntary manslaughter by means of assault was required for inclusion.

3.3.3 Study V

In the fifth study, we identified a total of 71 child-homicide victims during the period January 1, 1994, to December 31, 2012 by way of combining the NBFM in-house autopsy database (RättsBase) with the NRCC (Figure 5). Victims of extra-familial child homicide were excluded, along with victims who had been killed by family members other than their parents (i.e., intra-familial non-filicide child homicides). Also, children who had died within 24 hours of birth were excluded, since they were deemed unlikely to have been treated for injuries other than those present or sustained at birth. Further, a total of 355 living controls (matched for sex as well as year and parish of birth) were randomly generated in a ratio of 5:1 from the Total Population Registry with the aid of Statistics Sweden.

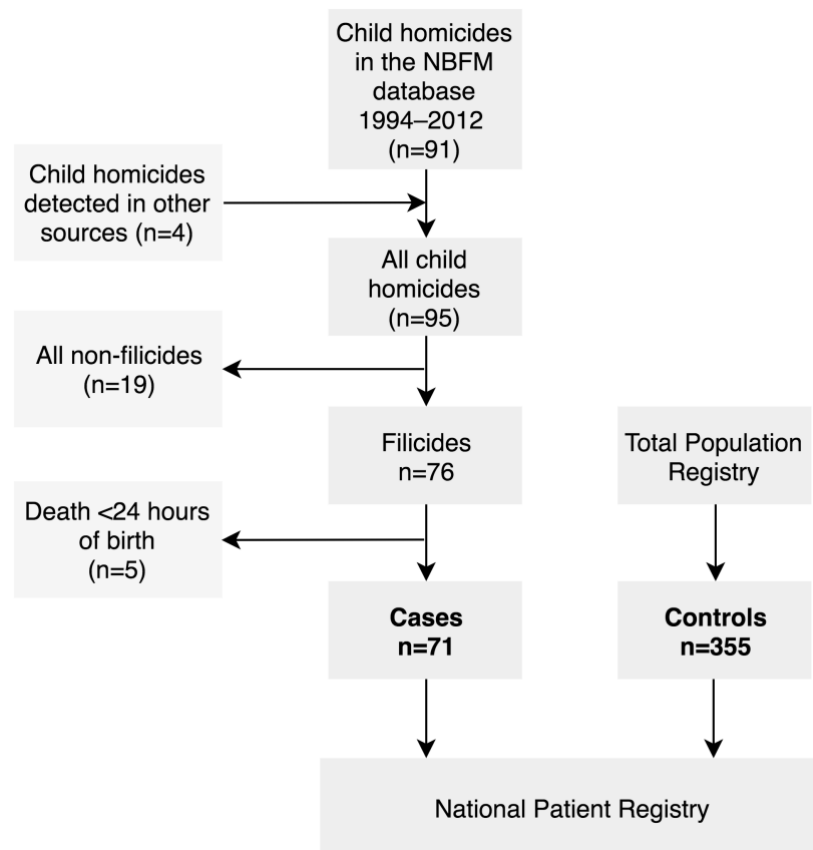


Figure 5. Selection process of cases and controls in study V.

3.4 STATISTICS

3.4.1 The probability value and the confidence interval

In order to grasp the meaning of the probability or p value, one has first to comprehend the concept of hypothesis testing, which is a key ingredient in inferential statistics (De Muth, 2008). Usually, two mutually exclusive and exhaustive statements relating to the research question are formulated, the “null hypothesis” (H_0) and the “alternative hypothesis” (H_1). For example, the H_0 might state that there are no differences with regard to outcome between two types of treatment in a population of patients; whereas H_1 , on the other hand, might indicate that differences are present. The p value is generated in different ways depending on the type of analyses that are conducted. In essence, it indicates the confidence with which a researcher can claim that the results also hold true for the population from which the sample was drawn. A p value of 0.05 indicates that the probability of yielding the observed result – or an even more extreme result – is 5% given that the null hypothesis is true. The frequent use of p values in academia – and the commonly used arbitrarily set cut-off of 0.05 – has been a topic of intense debate during recent years (see, for example [Lew, 2013; McShane, Gal, Gelman, Robert, & Tackett, 2017; Rothman, 2014]).

The confidence interval (CI) is influenced by both the distribution of the data and the sample size. It is related to the p value, but not quite the same (du Prel, Hommel, Röhrig, & Blettner, 2009). A CI is bounded by two limits within which the researcher – with a pre-defined degree of certainty – can be sure to find the true population value. For instance, a 95% CI between 3

and 5 means that the researcher can be 95% confident that the true population value lies within that range.

3.4.2 Regression analysis

When using regression analysis, we are interested in fitting a mathematical model to our data (Motulsky, 2014); for instance, we may want to investigate how changes in a variable “x” influence a variable “y”. In this case, “y” represents a *dependent* variable (sometimes denoted *response* or *outcome* variable) and “x” represents an *independent* variable (also commonly called a *predictor* or *covariate*). The goal of regression analysis is to make inferences on the population of interest based on data from a sample. Regression models often incorporate several independent variables, regardless of variable type; a strength of the method is that both categorical and numerical variables can be included in the same model (Wiest, Lee, & Carlin, 2015). Moreover, the method makes it possible to estimate the effect that each independent variable has on the dependent variable when the other predictors are held constant. Another important strength of regression analysis is its ability to control for the effects of potentially confounding variables on the outcome. Various regression models have been developed, the most straightforward of which would be linear regression, which, in its simplest form, may be thought of as the fitting of a line to continuous data (“the equation of a straight line”).

3.4.2.1 Logistic regression

Logistic regression is a versatile and popular statistical method that is applicable when the outcome of interest is binary, which means that it either takes on the value of “0” or “1”. Logistic regression is thus commonly employed in the field of life sciences, in which outcomes such as “healthy” versus “ill” or “alive” versus “deceased” many times are of interest. Further, the results of logistic regression are presented in the form of odds ratios (i.e., the ratio of the odds for an event given different exposures), which, to the initiated reader, is an intuitive estimate of the relative risk; such estimation is particularly the case when we deal with rare outcomes (A’Court, Stevens, & Heneghan, 2012; Davies, Crombie, & Tavakoli, 1998; Viera, 2008). Moreover, the precision of the inferred risks is captured in an accompanying confidence interval; however, if that interval includes unity, a statistically significant inference cannot be made (Stoltzfus, 2011). A certain type of logistic regression – *conditional* logistic regression – is recommended when there is an inherent dependency in the data, as is the case in the fifth study in which controls were matched to cases. Dependency in the data can also occur if individuals are sampled repeatedly across time (i.e., “longitudinal data”) or from specific locations, such as certain schools or hospitals (i.e., “clustered data”).

3.4.2.2 Poisson regression

Poisson regression models are used in various fields of research, not least in criminology (Osgood, 2000) and homicide research (see, for example, Swinson et al., 2011). The methodology is suitable when the data at hand can be characterized by a Poisson distribution (Hayat & Higgins, 2014), which is a probability distribution that applies to count data (i.e.,

discrete, non-negative whole numbers). Furthermore, in the case of rare events (such as, for instance, child homicide), it is advisable to conduct a Poisson regression owing to the skewness of the data (Osgood, 2000). Predictors can be included in the model, for instance, the number of individuals of a certain age during a study period. In a certain type of Poisson-regression modeling, the outcome coefficient corresponds to the incidence rate ratio (IRR). For example, an IRR of 0.9 means that the rate of the studied events has declined by an average of 10% annually.

3.4.3 The chi-squared test and Fisher's exact test

The chi-squared test can be used for hypothesis testing when categorical (nominal) data are under investigation – such data that preferably can be presented in a two-by-two contingency table, for example, the occurrence of cough (present/not present) by asthma status (present/not present) (Wissing & Timm, 2012). The test answers the question whether the proportions of observed categories differ significantly from what would be expected if the null hypothesis were true (Wissing & Timm, 2012). An advantage of the test is that it is fairly easy to comprehend and to calculate by hand; however, one drawback is its reliance on the assumption that the sample is large (Kim, 2017). By contrast, a method known as Fisher's exact test is difficult to calculate by hand, but is able to provide exact results without relying on assumptions. Fisher's exact test has been recommended when more than 20% of the cells of the contingency table have expected frequencies less than 5 (Kim, 2017). Note, however, that the test is applicable regardless of sample size.

3.4.4 The toxicology-based studies

In the first study of the present thesis, we employed logistic regression, as well as a chi-squared test and Fisher's exact test. Logistic regression was also used in the second and third studies. In the second study, estimates from such modeling were adjusted for age, whereas in the third study, estimates were adjusted for both age and sex. As mentioned previously, in the third study, we set out to examine to what extent congruence between dispensed prescriptions and toxicology would influence the risk of homicide offending and victimization. In order to do that, so-called dummy variables were created based on study subjects' status with regard to toxicology (positive/negative) and dispensed prescription during the 6 months prior to the fatal event (filled prescription(s)/no filled prescription). Different versions of the SPSS statistical software (IBM SPSS Statistics for Macintosh) were used in all of the toxicology-based studies; in study III, regression modeling was also performed using the statistical software R (with identical outcome).

3.4.5 The child-homicide studies

In study IV, we conducted Poisson regression modeling to estimate incidence rate ratios (IRRs) using the statistical software Stata (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP). In a first calculation, we used the number of child-homicide victims (n=115) as the dependent variable; further, we set the exposure variable to all residents under age 15 years, and years as the linear predictor. For the

purpose of a second calculation, we first defined a depressive-offender proxy as the combined measure of the number of perpetrators who had committed suicide plus the number of perpetrators who had been diagnosed with an affective disorder (unipolar or bipolar depression) upon forensic-psychiatric evaluation. Second, we estimated an IRR with the proxy measure as the dependent variable, years as the linear predictor, and individuals aged 15 or older as the exposure variable. All other statistical analyses in study IV were performed using SPSS version 22 for Mac (IBM SPSS Statistics for Macintosh).

As stated previously, in the fifth study, we made use of controls who had been matched according to three variables: sex, birth year and parish of birth. In order to account for the dependency in the data, conditional logistic regression was employed (Niven, Berthiaume, Fick, & Laupland, 2012; Pearce, 2016). All analyses were conducted using SPSS version 23 for Mac (IBM SPSS Statistics for Macintosh).

4 RESULTS

Since all of the included studies are appended to the thesis, their results will here be briefly summarized, with a focus on the main findings.

4.1 THE TOXICOLOGY-BASED STUDIES

4.1.1 Study I

A little more than half of victims and perpetrators of homicide displayed positive toxicology (57.0% of victims and 62.5% of offenders) with respect to alcohol and/or narcotics. The most commonly detected substances, in both victims and perpetrators, were ethanol (44.9% versus 40.8%) and, as a class, benzodiazepines (8.3% versus 19.2%). With regard to benzodiazepines, a statistically significant ($OR=2.6$; $p=0.002$) difference was uncovered between offenders and victims. Individuals who had committed homicide followed by suicide displayed a significantly lower rate of positive toxicology (30.8%) than other homicide offenders (67.3%; $p=0.01$). Victims in cases that remained unsolved at the time of the study more often displayed positive drug toxicology compared to their counterparts in solved cases (36.1% versus 8.3%; $p<0.001$). Moreover, perpetrators of child homicide were considerably less often positive (20.0%) with regard to psychoactive substances than the remaining perpetrators (66.1%, $p=0.05$). For both victims and offenders, positive toxicology was more commonly detected in cases that had occurred during the nighttime compared to daytime as well as on weekends compared to weekdays. Finally, after dichotomization of toxicological results as either positive or negative, an overlap of 48.2% was noted in the category in which both the victim and the offender were positive with respect to ethanol and/or narcotics.

4.1.2 Study II

We found that the toxicological presence of ethanol conferred a statistically significantly increased risk of both homicide offending (adjusted $OR=3.6$; 95% CI: 2.3–5.6) and victimization ($aOR=2.1$; 95% CI: 1.4–3.0). After stratification by sex, risk estimates in females were about 3-fold greater than in males with regard to both homicide offending ($[aOR=11.0$; 95% CI: 2.4–49.8] versus $[aOR=3.1$; 95% CI: 1.9–4.9]) and victimization ($[aOR=5.4$; 95% CI: 2.4–12.2] versus $[aOR=1.7$; 95% CI: 1.1–2.8]). Sensitivity analyses were performed using a control group composed of individuals who had been involved in vehicle accidents either as pedestrians or passengers. The results of those analyses were similar to the results in the main analyses, albeit – as expected – with wider CIs; estimates here were more than three times higher in female than male subjects regarding both homicide offending ($[aOR=13.3$; 95% CI: 2.4–75.3] versus $[aOR=3.6$; 95% CI: 1.8–7.1]) and homicide victimization ($[aOR=6.7$; 95% CI: 2.1–21.6] versus $[aOR=2.1$; 95% CI: 1.0–4.0]).

4.1.3 Study III

In this study, analyses were carried out by way of two separate approaches; first, with regard to antidepressants and mood stabilizers/antipsychotics, we were interested in uncovering non-adherent subjects (in the article, we use the term incongruence to denote subjects with

negative toxicology with respect to a certain medication despite having filled at least one prescription of that medication); second, we were interested in uncovering subjects with a recreational use of GABA-ergic hypnotics (analogously, in the paper, we use the term incongruence to denote individuals with positive toxicology in the absence of relevant dispensed prescriptions).

Using the first approach, we found that congruence between dispensed prescriptions and toxicology for antidepressants did not significantly affect the risk of homicide offending (aOR=1.2; 95% CI: 0.5–3.1) or homicide victimization (aOR=1.2; 95% CI: 0.7–2.2). By contrast, incongruence was associated with a significantly increased risk of homicide offending (aOR=6.2; 95% CI: 3.3–11.6) but not homicide victimization (aOR=0.8; 95% CI: 0.3–2.0). Similarly, incongruence between dispensed prescriptions and positive toxicology for antipsychotics and mood stabilizers was associated with a significantly increased risk of homicide offending (aOR=7.0; 95% CI: 2.8–17.7), whereas congruence did not significantly affect the risk of either homicide offending (aOR=3.0; 95% CI: 0.9–10.5) or homicide victimization (aOR=2.3; 95% CI: 0.9–5.8).

When employing the second approach, we found that both congruence and incongruence between positive toxicology and dispensed prescriptions for GABA-ergic hypnotics were significantly associated with increased risks of both homicide offending (aOR=5.4 [95% CI: 2.6–11.0] and aOR=4.9 [95% CI: 2.6–9.3], respectively) and homicide victimization (aOR=2.1 [95% CI: 1.1–4.2] and aOR=3.2 [95% CI: 1.7–6.1]).

In order to investigate the robustness of the findings, sensitivity analyses were performed using a subset of controls in whom medication-taking behavior was assumed to have had less impact on the outcome than in the entire population of controls: individuals who were involved in accidents either as pedestrians or as passengers in vehicles. Estimated risks turned out to be similar to those in the main analyses, with two exceptions that deserve to be mentioned. First, when perpetrators of homicide were compared to passenger and pedestrian controls, the risk estimate relating to incongruence between dispensed prescriptions and positive toxicology was nearly doubled for antipsychotics and mood stabilizers (aOR=12.5; 95% CI: 2.3–68.0); second, when the same groups were compared with regard to GABA-ergic hypnotics, the risk estimate for congruence between dispensed prescriptions and toxicology was increased by a similar magnitude (aOR=8.7; 95% CI: 2.5–30.0).

4.2 THE CHILD-HOMICIDE STUDIES

4.2.1 Study IV

In the fourth study, we found, by way of Poisson regression modeling, a 4% annual decrease in child homicides during the period 1992–2012, in accordance with a prior study that made use of a subset of our data (Sturup & Granath, 2015). However, contrary to our hypothesis, no marked decrease was found regarding depressive offenders, as measured by a previously mentioned proxy. Upon FPE, fifty child-homicide offenders had been assigned one or more diagnoses pertaining to the following diagnostic categories: substance misuse

(8%), affective disorders (10%), autism-spectrum disorders (18%), psychotic disorders (28%) and personality disorders (30%). A third of the extra-familial offenders had been diagnosed with an autism-spectrum disorder, but no personality disorders had been found in that group. Furthermore, half of the offenders who had undergone FPE were adjudged to have an average level of intellectual functioning, and the majority of them had at least completed secondary education.

Prior violent offenses were more common among perpetrators of filicide than filicide–suicide (17.8% versus 6.9%); and about 20% of offenders in each group had previously received psychiatric inpatient care. The time from last discharge to child homicide was nearly doubled in the filicide-only group compared to the filicide–suicide group: 2236 versus 1177 days. A more pronounced difference was seen when the filicide and filicide–suicide offenders were compared to extra-familial offenders with respect to the same parameter: 1883 versus 168 days. Aggressive methods of filicide predominated among fathers. Highly lethal methods of filicide (firearms, fire) were more commonly followed by same-method suicide than less lethal methods. Also, with regard to the included filicides, blunt violence was exclusively used in cases that were not followed by offender suicide.

4.2.2 Study V

We found that prior inpatient care conferred a statistically significant 5-fold risk of filicide victimization (OR=5.00; 95% CI: 1.75–14.26), whereas prior outpatient care, or any prior healthcare use, did not significantly increase the risk. After stratification by sex, no statistically significant risk increases were found for males. For females, on the other hand, prior inpatient care conferred a statistically significant 7-fold risk (OR=6.67; 95% CI: 1.49–29.79), and any prior medical care a statistically significant 4-fold risk (OR=3.57; 95% CI: 1.13–11.25) of filicide victimization. However, it should be pointed out that, for females, the risk estimate for prior outpatient care was not significantly elevated; thus, the 4-fold risk conferred by any prior medical care appears to be conditioned by the elevated risk conferred by prior inpatient care.

In none of the included cases had the treating physician identified the injury as the result of intentional abuse. With regard to means of violence, the largest subgroup was asphyxia (32%) – including strangulation, smothering or drowning – followed by sharp-force trauma (18%) and blunt-force trauma (17%). In our dataset, filicide followed by offender suicide (filicide–suicide) was common, comprising 37% of all homicidal events.

5 DISCUSSION

5.1 THE TOXICOLOGY-BASED STUDIES

5.1.1 Study I

In the first study, we primarily had the ambition to describe toxicological findings in a population of homicide offenders and victims. The study's major strength is the inclusion of toxicology from homicide *offenders* – quite a rarity in this field of research (Darke, 2010; Kuhns et al., 2013). The most intriguing finding is that of benzodiazepines being significantly more common in homicide offenders than victims. Indeed, in forensic-psychiatric practice as well as in academia and in other contexts, these substances have been shown to be associated with violent behavior (Albrecht et al., 2014, 2017; K. Jones, Nielsen, Bruno, Frei, & Lubman, 2011; Rouve et al., 2011), agitation and paradoxical reactions (Bramness, Skurtveit, & Mørland, 2006), as well as increased all-cause mortality (Kripke, Langer, & Kline, 2012; Tiihonen, Suokas, Suvisaari, Haukka, & Korhonen, 2012). However, since we lacked prescription data, we were not able to determine whether the benzodiazepine use had been recreational or prescribed by a treating physician.

Further, the finding that homicide–suicide offenders displayed positive toxicology significantly less often than the other homicide offenders, warrants attention. A possible explanation, which is supported by the literature (Flynn, Gask, Appleby, & Shaw, 2016; Knoll & Hatters-Friedman, 2015; Panczak et al., 2013; Roma et al., 2012), may be that other psychopathological processes (for instance, depression or psychosis), to a greater extent than the acute effects of alcohol or narcotics, have influenced homicide–suicide offenders' actions at the time of the fatal events. In addition, we found that positive toxicology appeared to be less common in perpetrators of child homicide – a finding that was corroborated in the fourth study, which made use of a different dataset.

The finding that positive toxicology with respect to narcotics was more common in victims of unsolved cases is hardly surprising. Presumably, a fairly high proportion of these incidents had been carried out in the context of drug-related criminal enterprise, where conditions facilitating police work are less favorable. Also hardly surprising is the finding that positive toxicology was common in cases that occurred during the nighttime or on weekends. The well-established Swedish habit of episodic heavy drinking (i.e., “binge drinking”) can be expected to give rise to such an unbalanced pattern across time (Reich, Cummings, Greenbaum, Moltisanti, & Goldman, 2015; Svensson & Landberg, 2013); and, interestingly, a similar pattern of significantly higher rates of positivity for ethanol during the weekend compared to weekdays has been reported among injured patients in a Norwegian emergency department (Bogstrand et al., 2011). Finally, we found that about half of the cases – for which we had access to both offender and victim data – displayed positive toxicology in both parties. That finding is consistent with prior research, whereby a substantial portion of homicides occur following altercations between individuals who consume alcohol together

(Cros, Alvarez, Sbidian, Charlier, & Lorin de la Grandmaison, 2012; Wahlsten, Koiranen, & Saukko, 2007).

5.1.2 Study II

The second study can be viewed as a natural extension of study I. By using a control population, study II provides estimates of homicide risk that appear more intuitively comprehensible than the comparisons between victims and offenders presented in study I. As mentioned, we assessed risks of homicide offending and victimization conferred by the toxicological presence of ethanol at the time of the offense. As also mentioned, we found that the presence of ethanol, among females, conferred a more than 10-fold risk of homicide offending and a more than 5-fold risk of homicide victimization. Since risk estimates for males were somewhat lower, our results imply that consumption of alcohol may be a more important risk factor for homicidal outcome in females than in males. Yet, as highlighted in a meta-analysis (Kuhns et al., 2011), sex and age breakdowns are rarely reported in this field of research; however, according to some of the studies included in the meta-analysis, female victims are substantially more likely to have tested positive for ethanol than male victims (48% versus 28%). Also, our results are in line with those of Chang and co-workers (2015), who, in a cohort of Swedish prisoners, found that a diagnosis of alcohol use disorder had a stronger effect on violent reoffending in females than in males.

Our study's hypothesis – that ethanol positivity would increase the risk of involvement in homicide – was supported by the data both before and after stratification by sex. The commonly held belief that alcohol consumption increases the risk of violent behavior is thoroughly supported in the literature; however, whether alcohol is causally linked to homicide *victimization* or is merely associated with other etiologically more important factors is less clear. It is conceivable that both males and females become less capable of defending themselves against violence while intoxicated; yet, it may also be the case that alcohol is merely a marker for situational contexts in which violence is likely to occur. Moreover, the results of study II should be interpreted in the light of prior research on sex-related differences associated with alcohol use. For example, heavy-drinking females are more likely to display psychiatric comorbidity than their male counterparts, and alcohol-using females also appear to develop neurotoxic effects of alcohol (e.g., volumetric brain loss and cognitive deficiencies) more quickly than males (Erol & Karpyak, 2015). Undeniably, such circumstances may affect an individual's propensity for involvement in violence and homicide.

After submission of the manuscript, one of the reviewers raised concerns regarding the fairly small subsample of offenders for whom toxicological results were available. The point is well taken, although one should be aware of the dearth of previous studies that have been able to include relevant toxicology for offenders. As pointed out earlier, only one study in Kuhns' meta-analytic review (Kuhns et al., 2013) supplied actual toxicological data for offenders: a more than half-century old survey from a single

American city (Shupe, 1954). Further, in all likelihood, the rather generous inclusion limit of 48 hours may have given rise to some falsely negative offenders, i.e., those who were intoxicated at the time of the offense but had metabolized ethanol completely at the time of sampling. Conversely, it is possible that a number of individuals may have been sober at the time of the offense but positive for ethanol upon toxicology owing to post-offense, pre-arrest drinking. Thus, for subjects who did not lose their lives in conjunction with the offense, it is not a straightforward task to delineate an optimal cut-off prior to which sampling had to have been performed. Misclassification is likely to have occurred to some extent, although it would be difficult to speculate about to what extent such misclassification may have affected estimates. Some additional limitations of study II and the other toxicology-based studies are further discussed below.

5.1.3 Study III

In the third study, we combined toxicological data with prescription data in order to assess risks of homicide offending and victimization conferred by non-adherence to psychotropic medications. To our knowledge, our study is the first to conduct such analyses using a population-based dataset, although comparisons between dispensed prescriptions and post-mortem toxicology have previously been reported in young suicide victims (Isacson & Ahlner, 2014). As stated in study III, our results appear to be intuitively sound. In all likelihood, on the basis of their prescribed medications, a substantial proportion of subjects can be assumed to have been diagnosed with depression, psychosis or bipolar disorder; as mentioned in the introduction, these conditions are associated with an increased risk of violence, and discontinued treatment can be assumed to elevate the risk even further. By contrast, as indicated by similar risk estimates for medicinal and recreational use, ongoing consumption, either licit or illicit, of GABA-ergic hypnotics increased the risk of involvement in homicide; however, this finding, too, is hardly surprising given the known pharmacodynamic properties of benzodiazepines and Z drugs, which include disinhibition of violent impulses.

As pointed out by one of the reviewers after submission, the presence of substance misuse might be a confounding variable that merits adjustment. Indeed, it seems likely that substance misuse would influence the independent variable (adherence) as well as the dependent variables (homicide offending or victimization) and thereby fulfil the basic criteria of a confounder (the concept of confounding is further discussed below). Unfortunately, we did not have access to diagnostic data for all study subjects, and it was thus not possible to control for the effects of substance misuse. Nonetheless, after the article had already been accepted for publication, we decided to conduct additional analyses that made use of toxicological results of ethanol and narcotics at the time of the offense; individuals with positive results were considered as having a substance misuse. Needless to say, however, the toxicological presence of psychoactive substances at the time of the offense may not reflect an actual substance misuse.

In this supplementary analysis, we estimated risks by logistic regression, adjusted for age

and sex and after stratification by offense-related substance use (i.e., positive toxicology with respect to at least one of the following substances or substance classes: ethanol, benzodiazepines, Z drugs, cocaine, GHB/GBL, opioids, cannabis or amphetamines). As seen in Table 2, non-adherence to antidepressants together with offense-related substance use conferred a significantly increased 23-fold risk of homicide offending; the risk was attenuated, yet remained significant, in analyses of non-adherence without substance use (aOR=4.5; 95% CI: 1.3–16). Surprisingly, in analyses of antipsychotics and mood stabilizers, non-adherence together with substance use conferred a markedly lower risk (aOR=7.1; 95% CI: 1.9–4.6) than non-adherence without substance use (aOR=86; 95% CI: 14–520).

Antidepressants		
	<i>No substance use</i>	<i>Substance use</i>
No medication	1 (ref.)	5.1 (3.2–8.2)
Adherence	2.2 (0.5–9.5)	2.7 (0.8–9.0)
Non-adherence	4.5 (1.3–16)	23 (10–50)
Antipsychotics/mood stabilizers		
	<i>No substance use</i>	<i>Substance use</i>
No medication	1 (ref.)	5.5 (3.5–8.7)
Adherence	–	17 (4.2–71)
Non-adherence	86 (14–520)	7.1 (1.9–4.6)

Table 2. Odds ratios for homicide offending from logistic regression with corresponding 95% CIs, adjusted for age and sex, after stratification for substance use, by category of medication.

Discontinued treatment with antidepressants or antipsychotics and mood stabilizers appears to increase the risk of homicide offending – independent of any offense-related substance use. Thus, vigilance regarding such treatment might reduce homicidal violence. Counterintuitively, for antipsychotics/mood stabilizers, non-adherence in the absence of substance use was associated with a much higher risk than non-adherence and simultaneous substance use. Possibly, individuals treated with antipsychotics/mood stabilizers might, phenotypically, be categorized into two variants: first, a “high-risk” group composed of temperate subjects prone to non-adherence, who might be more severely ill and therefore potentially more dangerous when not medicated; second, a “low-risk” group of substance-misusing subjects who are less severely psychotic and hence pose less of a risk for violent criminality. Interestingly, senior forensic psychiatrists at the National Board of Forensic Medicine have long recognized these two subgroups in clinical practice; however, to the

best of my knowledge, no peer-reviewed work has been carried out on the topic.

Further, it cannot be ruled out that substance use may be a way for non-medicated individuals to “self-medicate” mood swings or psychotic symptoms, resulting in reduced risk of violence. Larger studies that incorporate other categories of psychotropic medications, as well as diagnostic information and psychosocial covariates, are warranted, to further explore the current findings. Note that the findings of these supplementary analyses must be interpreted with extreme caution on account of a few strikingly wide confidence intervals.

During the process of writing the thesis frame, I came to reconsider some of the findings of study III and was struck with a bit of concern regarding how the results had been interpreted (the study’s limitations are more thoroughly discussed below). As mentioned, we found significantly elevated risks of homicide *offending* (but not *victimization*) conferred by discontinued treatment with antidepressants, antipsychotics or mood stabilizers. Those estimates were, to a great extent, generated by the comparison of toxicology in living versus deceased subjects. Since the sampling of living subjects at times was undertaken after some delay, it is likely that some metabolism had occurred in a portion of those subjects – a circumstance that potentially could cause falsely elevated estimates. In other words, since we found a *pattern* of elevated estimates specifically with regard to homicide offending (and not victimization), it is hard to completely rule out the possibility that the elevated estimates simply may be an artifact caused by the timing of the sampling. On the other hand, the results of study II – which uncovered larger estimates relating to homicide offending than victimization – do not suggest that substantial effects have been caused by delayed sampling. That conclusion is further supported by a British study, in which patients with mental illness were found to be two times more likely to become perpetrators of homicide than victims of homicide (Rodway et al., 2014). Even so, had we included a range of “neutral” substances in our analyses (those that are not used to treat conditions known to be associated with violence, for example, antidiabetic or antihypertensive drugs) some guidance regarding the most reasonable interpretation of the results would possibly have been obtained. It can be noted that a similar approach was employed in a recent cohort study, in which adrenergic inhalants were used as a negative control (Chang, Lichtenstein, Långström, Larsson, & Fazel, 2016). Moreover, our decision to include prescription data during the 6 months prior to the fatal event is arbitrarily set and can thus be debated. In Sweden, prescriptions are valid during one year, although treatment can be discontinued at any point in time prior to that by a treating physician. In hindsight, it would have been interesting to perform additional sensitivity analyses using different cut-offs for prescription data (e.g., 4 or 6 or 12 months).

5.2 THE CHILD-HOMICIDE STUDIES

5.2.1 Study IV

One of the key findings of the fourth study is the fairly low rate of substance use among perpetrators of child homicide – a finding that contrasts sharply with previous research (not least study I in the present thesis), which has highlighted an association between drugs of abuse and violent behavior (Darke, 2010; Hoaken & Stewart, 2003; Tomlinson et al., 2016). However, with regard specifically to child homicide, the finding is in line with several previous publications that made use of datasets from different countries (Flynn et al., 2013; Putkonen, Amon, et al., 2009; Putkonen, Weizmann-Henelius, et al., 2009). Moreover, the fairly low rate of previous convictions among child-homicide offenders in our study lends further support to the notion that risk factors for child homicide only partly overlap with traditional risk factors for lethal violence. Along the same lines, we noted that child-homicide offenders appear to have better cognitive abilities, and to be more well-educated and possibly more well-adjusted, than the average offender who undergoes forensic-psychiatric evaluation. Note, however, that a recent American study has provided conflicting findings; when homicide offenders with solely child victims were compared to a group of offenders who had killed both children and adults, the former offenders scored lower on tests in every cognitive domain (Azores-Gococo, Brook, Teralandur, & Hanlon, 2017). The authors acknowledge some limitations of their dataset; at the same time, they make relevant remarks regarding the possibility that poor mental capacity and insufficient conflict-mediation abilities might increase the risk of extreme violence directed toward children.

Overall, the diagnostic findings of our study are in line with those of several previous studies (Bourget et al., 2007; Debowska, Boduszek, & Dhingra, 2015; Flynn et al., 2007, 2013; Hatters Friedman, Hrouda, et al., 2005; Lysell et al., 2014; Putkonen, Amon, et al., 2009), although inter-study comparisons in this field are problematic, as discussed in the introductory chapters. To our knowledge, the presence of autism-spectrum disorders has not previously been reported in a sample of child-homicide offenders, although such disorders have been noted among the victims (Coorg & Tournay, 2012; Palermo, 2003). It is plausible that the lack of autism-spectrum disorder diagnoses may be attributable to the fact that the neuropsychiatric field only recently has received widespread academic attention; consequently, older studies may have underestimated the prevalence of such disorders or diagnosed them as primarily psychotic (Cochran, Dvir, & Frazier, 2013). Of note, in a Swedish study that critically examined the increased prevalence of autism-spectrum disorders in children, the authors found the recent years' increase in diagnoses to be dependent upon many factors and not reflective of an actual increase in incidence (Lundström, Reichenberg, Anckarsäter, Lichtenstein, & Gillberg, 2015). Moreover, the occurrence of autism-spectrum disorders among extra-familial offenders can possibly be attributed to commonly occurring autistic signs, for instance, special interests, rigid thinking and difficulties regarding social and emotional reciprocity and shifting to others' perspectives (Schwartz-Watts, 2005). Indeed, all of the mentioned autistic features could theoretically increase the risk of

engagement in violent behavior – although conclusive evidence of a link between autism and violence did not appear in a recent comprehensive review (Im, 2016). Along the same lines, a Swedish population-based study found the association between autism and violent criminality largely to be explained by comorbid ADHD and conduct disorder (Heeramun et al., 2017). Further, the fact that autism-spectrum disorders were more common in extra-familial offenders than in intra-familial offenders may, at least to some extent, be explained by the increased likelihood that individuals with such disorders live alone (Roy, Prox-Vagedes, Ohlmeier, & Dillo, 2015).

The lack of personality disorders among the extra-familial perpetrators also calls for some discussion. As noted in our article, the mean age of those offenders was merely 21 years; since personality disorders seldom are diagnosed in teenagers and young adults (Chanen et al., 2004), it is plausible that the relative youth of the offenders may have influenced diagnostic considerations.

The rate of previous inpatient psychiatric care was found to be lower than the corresponding rate presented in an oft-cited Swedish study that made use of data from the years 1971 to 1980 (Somander & Rammer, 1991). Possibly, these differing findings can be explained by structural changes that have been implemented in the Swedish healthcare system during the last couple of decades. In short, the number of beds in psychiatric inpatient facilities has dropped substantially, while at the same time, outpatient care has expanded. Further, the different time intervals reported between discharge and child homicide should be interpreted with great caution. For example, one should refrain from concluding that a shorter time interval might indicate that an offender is more severely burdened by mental illness; it must be borne in mind that the number of individuals included in the study is low and that information regarding outpatient contacts is lacking.

In the fourth study, we first hypothesized that the rate of child homicides had decreased during the years 1992–2012. The results lent support to our hypothesis, and – as anticipated – the numbers were similar to those presented in a previous study, which was based on a subset of our data (Sturup & Granath, 2015). However, our second hypothesis, whereby we expected a decline specifically with regard to offenders suffering from depression, was not supported by the data. It should be noted that it is not possible to rule out the occurrence of such a decline, since our proxy measure may be invalid. Interestingly, however, a fairly recent study based on psychological autopsies has shown that 94% of American homicide–suicide offenders met criteria for a diagnosis of depression – a finding that supports the validity of our proxy measure (Knoll & Hatters Friedman, 2015).

Since our study did not include longitudinal data, it would be both ill-advised and presumptuous to engage in making causal inferences. Nonetheless, some factors that may be of relevance to our findings can be discussed in the light of official governmental socio-demographic data. For instance, as presented in the paper, the rate of children younger than 15 years of age who live with a single parent has dropped by almost 2 percentage points from 2000 to 2012. From the graphic presentation in the article, it is evident that the major drop in

child homicides occurred in the 1990s. Still, it is worth noting that the lack of a second guardian in single-parent households, theoretically, may have increased the risk of homicidal outcome according to the *routine activity theory*, originally coined the *routine activity approach* in a seminal article by Cohen and Felson (1979), which has influenced criminological research for decades. In brief, Cohen and Felson turned their attention toward the circumstances of a criminal act, rather than the offender who commits it, stating that criminal acts “[...] require convergence in space and time of likely offenders, suitable targets and the absence of capable guardians against crime” (Cohen & Felson, 1979). Finally, in our study, the rate of shared parental responsibility (in families with children aged 1–14 years) rose from 88.8% to 93.5% from 2000 to 2012 – a finding that may have influenced homicide risk in a similar way.

5.2.2 Study V

In study IV, the use of blunt violence was observed exclusively in cases of filicide that were not followed by offender suicide. Presumably, some of those events may be unintended filicides caused by abuse; as described in the literature (Hatters Friedman, Hrouda, et al., 2005), child abuse is seldom associated with filicide–suicide. An intriguing question would be whether better detection of child maltreatment might make possible interventions, thereby preventing fatal events. Relevant research in this field has been carried out by Guenther and co-workers (2009), who reported that abused children – compared to controls – were more likely to have made prior emergency department visits. In a subsequent study, the importance of confounding variables was highlighted, and the authors noted that frequent emergency department visits was not an independent risk factor for maltreatment in small children (MacNeill, Cabey, Kluge, Norton, & Mitchell, 2016).

As already stated, the fifth study set out to investigate whether prior healthcare use for injuries or intoxication would increase the risk of filicide victimization. To our knowledge, the study is the first of its kind, although a recent study that examined children’s use of emergency medical services employed a similar design (Shenoi et al., 2017). Another relatively similar study was conducted by Crandall and co-workers (2004), who, using a matched case-control design, found that previous emergency department visits – for example due to assault – conferred a heightened risk of involvement in (predominantly adult) homicide. Our study has one principal finding: that prior inpatient care conferred a 5-fold risk of filicide victimization in males and females taken together; and that this risk increase was primarily driven by a 7-fold risk in females conferred by prior inpatient care. Thus, our hypothesis – that prior healthcare use would confer an increased risk of filicide victimization – was partially supported by the data.

Our finding that prior healthcare use appears to increase the risk of filicide victimization may be explained in a number of ways. First, it may be the case that the recorded injuries that occasioned healthcare contacts may have been caused by abusive parents, although not identified as such by the treating physicians. At least two prior studies lend support to such an interpretation: a report by Wilczynski (1997), who uncovered that half of filicide victims had

been subjected to violence by the presumptive perpetrator prior to their death; and a report by Sidebotham and colleagues (2011), who, in a British dataset, found that about 40% of fatal child-maltreatment cases showed evidence of prior abuse or neglect. Second, it is possible that a presumptively filicidal parent is more likely, through general neglect, to put his or her child at risk for injuries. Third, it is also plausible that children to such parents are more likely to injure themselves due to behavioral problems.

In our study, the elevated risk estimates were mainly conditioned by higher odds of previous healthcare use for female victims – a finding consistent with the notion that males are more likely than females to acquire injuries. We were able to locate three recent papers in support of that notion, which appears to hold true irrespective of age; for instance, playground accidents in young children have been found to occur more often in boys (Bae et al., 2017), as have motor-vehicle accidents with victims up to 17 years of age (Dreyfus et al., 2016) and emergency admissions due to injuries in adolescents (Herbert, Gilbert, Cottrell, & Li, 2017).

As stated previously, nearly 40% of the included events were followed by offender suicide. The relatively high rate of filicide–suicides in our dataset may indirectly have influenced risk estimates in a conservative direction; since filicide–suicides are almost never committed as part of lethal abuse (Hatters Friedman, Hrouda, et al., 2005), it can be assumed that battering parents are represented to a lesser extent in our study. Indeed, in a prior Swedish study that included filicide cases between 1965 and 1999 (and thus partly overlapped with the current study), only about 10% of filicide offenders had both been motivated by aggression toward the child and ultimately beaten the victims to death (Nordlund & Temrin, 2007). Further, it has been suggested that the Swedish corporal-punishment ban – which was enacted in 1979 – has led to a dramatic decline in public support for physical punishment (Durrant, 1999). In addition, recent research has shown that the mortality rate due to abusive head trauma in infants was ten times lower in Sweden than in other Western countries (Andersson & Thiblin, 2018). Taken together, it cannot be ruled out that analyses of a different dataset, derived from a country with a higher public acceptance of physical punishment, would have yielded significant risk-estimate increases even in males.

The finding that death due to asphyxia was the largest subgroup of lethal violence is consistent with results from both a joint Finnish-Austrian study (Putkonen, Amon, et al., 2009) and a Canadian study (Dawson, 2015), but not with findings from studies based on American (Kajese et al., 2011; Sheno et al., 2013), French (Makhlouf & Rambaud, 2014), British (Sidebotham et al., 2011) and Taiwanese datasets (Hwa et al., 2015); in all of the latter studies, variants of head trauma (alternatively specified as blunt-force trauma) were found to be the most common means of violence. Although somewhat unlikely, these discrepant findings may imply cultural differences; another explanation may relate to differing proportions of stepparents and biological parents included in the respective datasets. Research has shown that homicidal biological parents are inclined to use methods that hasten death (for example, smothering or gun-shot trauma), whereas homicidal stepparents more often are motivated by anger and resentment and thus often resort to beating or bludgeoning (Daly &

Wilson, 1994; Weekes-Shackelford & Shackelford, 2004). Finally, it can be noted that the predominance of filicide victims in the younger age groups is well in line with results from studies conducted in other countries and other periods (Jason, 1983; Putkonen, Amon, et al., 2009; Roach & Bryant, 2015).

5.3 METHODOLOGICAL CONSIDERATIONS

5.3.1 Bias

Bias is a form of systematic error, which can be separated from random error on the basis of one central circumstance: when the study size increases, the random error becomes smaller whereas the systematic error remains unchanged. Bias is usually subcategorized in two major categories: *selection bias* and *misclassification bias* (the latter is sometimes referred to *information bias*) (Vandenbroucke et al., 2007). Selection bias can typically arise when the inclusion procedure of study subjects is flawed, so that subjects do not properly represent the population of interest. Also, selection bias can be introduced when subjects drop out of a study in a non-random fashion with respect to exposure status. Misclassification bias, on the other hand, typically stems from measurement error; for instance, if an interviewer is particularly interested in subjects with a certain diagnosis, he or she may spend longer time with those subjects and perhaps uncover pivotal information that would never have surfaced during a shorter interview. The net effect may be that subjects are improperly classified since the function of the instrument used for measurements (i.e., the interview) has a variable nature. With regard to the present thesis, a number of potential sources of bias can be identified, as discussed below.

5.3.2 Confounding

The term *confounding* can be described as a “confusion of effects”, which may occur when both the dependent and the independent variables are influenced by an additional (confounding) variable. The occurrence of confounding may cause spurious associations that threaten the validity of study results. One should keep in mind that, even after adjustment for a set of confounding variables, there is always a risk that the study results remain distorted, owing to so-called residual confounding. In the present thesis, a number of potentially confounding factors are likely to be present – both factors that easily can be identified and factors that cannot, as discussed in the forthcoming section.

5.3.3 Strengths, limitations and sources of bias and confounding

Arguably, their population-based design must be considered a major strength of all the studies included in the present thesis. In a population-based effort such as ours, registries with nationwide coverage are used in order to reduce selection bias and enhance the generalizability of the findings. It should be emphasized that none of the toxicology-based studies would have been possible to conduct without NBFM’s practice of performing toxicological analyses *routinely*; without such routine procedures, the introduction of selection bias is inevitable.

The results conveyed in the present thesis should be interpreted in light of several important limitations, some of which have already been touched upon. Indeed, the fairly low rate of sampled homicide offenders in studies I–III may have introduced a selection bias; it is possible to speculate that the offenders who were not included in our study may have been relatively free from severe mental illness or intoxication, since they were capable of avoiding early arrest. Conversely, the living offenders who were ultimately included all had been arrested speedily – a circumstance that may indicate a low level of psychosocial functioning. Thus, it is possible that the offenders in our sample may be disproportionately composed of perpetrators of “abnormal homicide” – a loosely defined term often used in reference to homicides committed by individuals who are afflicted with mental illness or who commit suicide in conjunction with homicide (Coid, 1983; Simpson, Skipworth, McKenna, Moskowitz, & Barry-Walsh, 2006). Indeed, that supposition is supported by the association between mental illness and close-contact methods of homicide (Abreu Minero et al., 2017), combined with the reduced likelihood of clearance in cases that involve distant-contact methods such as shooting (Sturup et al., 2015).

Our use of vehicle-accident victims as controls in studies II and III has been met both with criticism and approval. A potential problem may arise from the fact that the recruitment period for these controls was markedly longer than the corresponding period for the cases. Also, admittedly, the controls are not a randomly selected portion of the source population; since we were in need of specific toxicological data, such an ideal, random sample was not attainable within the bounds of feasibility. Taken together, the control population may have an inherent selection bias; possibly, the magnitude of that bias would have been smaller if we had been able exclusively to include cases in which the driver likely had had minimal influence on the fatal outcome (e.g., victims of fatal collisions with wild animals). Further, with regard to the toxicology-based studies, some misclassification bias may have occurred: certain results may have been influenced by inadequate specimen handling, and there is also some risk of post-homicide drinking, as well as post-mortem alcohol formation. Such alcohol formation, however, is unlikely to have affected the results of our studies, since virtually all bodies in the included cases were retrieved swiftly. Moreover, post-mortem alcohol formation is particularly unlikely to have affected estimates relating to homicide *victimization*, since problems of that sort would tend to balance out when groups of deceased individuals are compared.

As briefly discussed previously with regard to study II, the 48-hour cut-off for biological sampling may have introduced a misclassification bias. Since ethanol is metabolized continuously in living subjects, some offenders who had ingested alcohol prior to the offense may nonetheless have displayed negative results upon toxicological sampling. The same type of bias may be present in study III, whereby offenders who in reality were adherent to psychotropic medication were, owing to delayed sampling, mistakenly classified as non-adherent. In other words, misclassification of offenders as abstinent would bias results toward underestimation of risks conferred by alcohol, whereas misclassification of offenders as non-adherent would bias result toward overestimation of risks conferred by

discontinued pharmacotherapy. On the other hand, post-offense metabolism of GABA-ergic hypnotics would bias results toward an underestimation of risks for homicide offending, in the case of both recreational and medicinal use. Were it to be the case that offenders had ingested alcohol or taken medication post offense but prior to sampling, then results would tend to be biased in the opposite directions. Furthermore, with regard to study III, one should be aware that the half-lives of different substances – as well as the limits of quantitation for the same substances – vary and may potentially bias results in either direction (Schulz, Iwersen-Bergmann, Andresen, & Schmoldt, 2012; Smith et al., 2007). In addition, the dosages of prescribed medications, the individual therapeutic concentrations, as well as the level of activity of enzymes included in the metabolic pathways, is capable of distorting estimates.

One potential and likely confounder was mentioned earlier in the discussion section regarding study III: substance misuse; the attentive reader might remember that we also conducted additional analyses after stratification with a view to estimate risks unaffected by this confounder. There are numerous other potentially confounding variables that we, unfortunately, have not been able to include in our regression models. Such variables might include socio-economic status, marital status, housing situation, level of education and line of work – since all of them likely have the potential to affect both the independent and dependent variables in studies II and III.

When conducting registry-based studies, the researcher must have faith in the quality of the data at hand. Certainly, the self-reported information (for example, regarding schooling, in study IV), to some extent, has given rise to information bias. In addition, such bias may have arisen during the processes of setting up the databases and retrieving data from them.

The use of a *matched* case-control design in study V calls for discussion from a methodological point of view. Matched studies are common in the scientific literature, and their benefits and shortcomings have been extensively debated throughout the years (see, for instance, Rose and van Der Laan [2009], in which a brief literature review is provided). The main advantage of a matched case-control study has been suggested to be its ability to adjust for confounding (Rothman, 2012), as well as its increased efficiency compared to an unmatched study (Vandenbroucke et al., 2007). However, by matching on a variable assumed to be a confounder, it is possible that the distribution of exposure in the control series is shifted toward that of the cases; in such a situation, a selection bias has been introduced, since the exposure among controls does not represent the exposure in the source population (Rothman, 2012; Vandenbroucke et al., 2007). Several scholars opine that matched case-control studies should be used in special cases (for example in twin studies), but otherwise be avoided in favor of studies with an unmatched design, in which adjustment for potential matching variables is performed in the analysis (Costanza, 1995; Rose & van der Laan, 2009; Vandenbroucke et al., 2007). Hence, with regard to study V, in our effort to control for confounding (and, to some extent, increase efficiency), we may instead have introduced a selection bias – the magnitude of which, however, is difficult to estimate.

6 ETHICAL CONSIDERATIONS

There are a number of ethical questions that need to be considered when conducting research in the field of lethal violence. First and foremost, as in the present studies, sensitive information – derived from both living and dead individuals – is many times included. Needless to say, such information – if handled inappropriately – may inflict considerable damage upon living study subjects, as well as upon the relatives of deceased ones. Therefore, it is imperative that routines and regulations that relate to confidentiality are carefully upheld. All studies in the present thesis have received ethical approval by the Regional Ethical Review Board in Stockholm (reference numbers: 2010/1764-31/5 and 2013/13-31/5). In one case, an advisory opinion was issued by the board (reference number 2013/1411-31/5) concerning the use of forensic-toxicological data based on samples from individuals who had died by suicide. In that particular case, the board stated that the *Ethical Review Act* does not pertain to information from deceased individuals; thus, the ethical application was not subject to scrutiny.

The present thesis includes two studies that deal with lethal violence against children – a topic that usually attracts substantial attention from the media and the public. Consequently, the nature of the data used in the mentioned studies might call for careful consideration regarding questions of ethics and confidentiality. Since the studies include cases from the early 1990s and onwards, it can be assumed that some of the offenders at present are leading normal lives surrounded by people who have no knowledge of their past. Further, owing to the rarity of child homicide, some of the cases may be easily identified in a scientific report despite removal of case-specific identifiers.

For obvious reasons, we have not been able to obtain informed consent from study subjects who are deceased. For living subjects, on the other hand, such consent would be theoretically possible to obtain. However, prior to my involvement in the project, a decision was made to refrain from getting in contact with living subjects or their relatives, since it was assumed that such contact would evoke undesirable memories and emotions. In other words, having made contact with those individuals might have caused them more discomfort than allowing them unknowingly to be included in the present registry-based research. Further, one may argue that the few living subjects who were unaware of their inclusion in the present, anonymized, registry-based studies most likely have suffered less harm than individuals included in clinical trials which entail potentially harmful interventions.

A key point in research ethics concerns the need to get studies published, thereby making them accessible to the scientific community and the general population. To be clear, any risk or suffering brought upon study subjects should be weighed against the gain in knowledge a proposed study can potentially generate. Thus, getting manuscripts published, in a way boils down to a question of ethics. Further, it can be argued that publication ideally should be pursued in an open-access format in order to facilitate maximum dissemination of findings; however, for economic reasons, we have been forced to depart from that ethical principle and submit our manuscripts to traditional journals that make use of paywalls.

There is one more point to be made with regard to ethics. The research field of lethal violence may possibly provide the researcher with unique ethical challenges that exceed those in many other research areas. Indeed, each homicide case includes at least one victim and one perpetrator, and thus, in a way, polarizes “good” against “evil”. The researcher must be attentive to his or her mindset and remain objective and clear-headed without being influenced by judgmental views put forth by fellow researchers, journalists or members of the public.

7 CONCLUSIONS AND FUTURE PERSPECTIVES

The studies included in the present thesis add to prior research in different ways. Arguably, the results of study III deserve particular attention; with a partially novel approach, we were able to estimate risks of homicide offending and victimization conferred by discontinued treatment with psychotropic medications. Even though our results must be interpreted cautiously in view of the small study samples and the possible presence of residual confounding, it is our hope that policy makers and healthcare practitioners will be made aware of the potentially fatal effects that discontinued treatment with antidepressant or antipsychotic and mood-stabilizing medications might have. In addition, our results regarding the association between GABA-ergic hypnotics and involvement in homicide merit attention – not least since prior research in this field is limited. Many colleagues in forensic-psychiatric practice bear witness to the often rapid elicitation of aggressive behavior seen in users of GABA-ergic hypnotics, such as benzodiazepines and Z drugs. Our study suggests that limiting the use of such medications might contribute to a reduction of homicidal violence; in all likelihood, such measures could also affect the occurrence of severe non-lethal violence.

Our results also corroborate a wealth of prior research indicating that alcohol is a risk factor for lethal violence; however, by providing risk estimates based on objective measures, we have uncovered a particularly high risk of involvement in homicide for females following alcohol use. Consequently, healthcare interventions aimed at improving female drinking habits may, at least to some extent, be beneficial in reducing homicidal outcome. Importantly, reducing the burden of substance misuse in females is desirable also from another perspective: it has been reported that the negative health impact of drug use has increased more rapidly among females than among males during the last decade (United Nations Office on Drugs and Crime, 2017).

Future studies should ideally include larger datasets, preferably collated from multiple countries; also, in order to assess primary adherence, it would be of special interest to retrieve information regarding all issued prescriptions rather than merely dispensed ones. Unfortunately, at the moment, there exists no registry that includes individual-level data regarding the totality of issued prescriptions in Sweden. Moreover, in future studies of adherence to medication, it would be of interest to add diagnostic information, as well as more detailed information regarding the timing of sampling of living subjects. Further, hair analysis is a fairly recent addition to the field of forensic toxicology, with potential to advance our understanding of the relationship between medication adherence and violence (Xiang, Shen, & Drummer, 2015). By analyzing drug metabolites in hair, it is possible to create a timeline of medication adherence for a retrospective period of about 12 months, which, in turn, enables studies with an intra-individual design in which subjects serve as their own controls. In addition, it has not escaped our notice that the methodology used in study III may be useful also in other research areas. For instance, by comparing dispensed prescriptions with toxicological findings, it would be possible to investigate to what extent

discontinued treatment with antidepressants or other psychotropic medications influences suicidal behavior.

It should be borne in mind that Sweden has undergone structural changes with regard to lethal violence in recent years: a surge of firearm-perpetrated homicides in the context of other criminal activities has been reported, along with decreasing clearance rates (Granath & Sturup, 2018; Sturup, Rostami, Gerell, & Sandholm, 2018). Against that backdrop, it seems imperative to allocate resources to police and research initiatives aiming at increasing the general knowledge of organized crime in our country. It should be noted that the suggestions put forth above regarding increased adherence to medication would likely have minimal effects on the rates of lethal violence committed as part of gang-related criminal activities or other organized crime; indeed, research has shown that individuals with major mental disorders contribute very little to the totality of violent crime (Falk et al., 2014).

With respect to child homicide, we have uncovered a reduction in the occurrence of such events, but – to most people – any reduction short of complete elimination would probably be viewed as unsatisfactory. We have also provided demographic data, as well as other information, that shed some light on commonly occurring health problems among perpetrators and victims of child homicide. Ideally, the findings may aid in identifying at-risk individuals who are in contact with healthcare practitioners, social workers and other public-sector employees. Unfortunately, research has shown that healthcare personnel (in this case, psychiatrists) are reluctant to inquire about maternal filicidal thoughts (Hatters Friedman, Sorrentino, Stankowski, Holden, & Resnick, 2008) – and such reluctance may also be present among other professionals in the public sector. Nonetheless, raising awareness about filicidal risks among healthcare practitioners and social workers is likely a crucial step in the process toward sound preventive decision making. Still, one must bear in mind that the low base rate of child homicide makes individual-level predictions exceedingly difficult, and alerts to the social services and the police should be preceded by prudent reflection. Future child-homicide research should ideally be undertaken within international collaborative efforts using unified coding schemes for all of the assessed variables. Larger datasets are needed to facilitate further exploration of different subcategories of child homicide – a key research initiative, if realistic preventive measures are to be formulated and implemented.

8 ACKNOWLEDGEMENTS

First and foremost, I want to express the sincerest possible gratitude to my principal supervisor, **Joakim Sturup**. During the years, I cannot think of any meeting with you that has not left me with regained energy and enthusiasm. I am convinced this thesis would never have been written without you. Thank you!

An almost equally important individual in this context is **Thomas Masterman**, one of my co-supervisors and a dear friend from back in 2009 when we both started our training in psychiatry at Psykiatri Sydväst. I truly treasure the many hours we have spent on your small balcony, trying our best to perfect whatever manuscript we were working on at the time. Thomas – you have committed yourself to my education in a way that far exceeds that which could be expected from a co-supervisor. For that I am deeply grateful.

My final two co-supervisors, professors **Marianne Kristiansson** and **Johan Ahlner**, are both immensely experienced scientists who have made important contributions to my learning process over the years. To Marianne I am particularly grateful – you introduced me to Joakim and also hired me as a soon-to-be forensic psychiatrist at the National Board of Forensic Medicine. Thank you both!

Further, I am indebted to **Ola Broström**, my mentor and former clinical supervisor. I have always looked forward to our meetings and hope they will continue post dissertation!

I would also like to thank **Tom Palmstierna** for support and encouraging e-mails throughout the years. **Gustav Granström**, **David Bergman**, **Mats Persson**, **Sara Rodre**, **Joar Guterstam**, **Ylva Andersson**, **Jenny Liljeberg**, **Jonas Svensson**, **Stefan Ståhle** and co-authors **Björn Bäckström** and **Jonas Forsman** all have made contributions that need to be acknowledged. Also, the exceedingly helpful research assistant **Eva Bjerke** must be mentioned. Thank you all!

I am also deeply grateful for the continuous support shown by my colleagues – former and present – at the Department for Forensic Psychiatry in Stockholm. You have all worked hard to cover for me when I have been absent for research and for that I am deeply thankful! I am equally thankful for the possibility to conduct research provided by my employer, the National Board of Forensic Medicine. Specifically, I want to thank my former and current bosses on all levels (in no particular order): **Patrik Backgård**, **Stefan Fohlheim**, **Eva-Lo Ighe**, **Marianne Kristiansson**, **Johan Larsson**, **Thomas Masterman**, **Fredrik Hedén**, **Erna Zelmin** and **Monica Rodrigo**.

Last, I would like to thank **Gabriella Bröms** and **Nitya Jayaram-Lindström** in their capacity of study directors of the Karolinska Institutet research schools in epidemiology and psychiatry, respectively.

9 REFERENCES

- A'Court, C., Stevens, R., & Heneghan, C. (2012). Against all odds? Improving the understanding of risk reporting. *British Journal of General Practice*, 62(596), 220–223.
- Abreu Minero, V., Barker, E., & Bedford, R. (2017). Method of homicide and severe mental illness: a systematic review. *Aggression and Violent Behavior*, 37(May), 52–62.
- Aebi, M. F., & Linde, A. (2014). The persistence of lifestyles: rates and correlates of homicide in Western Europe from 1960 to 2010. *European Journal of Criminology*, 11(5), 552–577.
- Aho, A. L., Remahl, A., & Paavilainen, E. (2017). Homicide in the western family and background factors of a perpetrator. *Scandinavian Journal of Public Health*, 45(5), 555–568.
- Albrecht, B., Staiger, P. K., Best, D., Hall, K., Nielsen, S., Lubman, D. I., & Miller, P. (2017). Benzodiazepine use of community-based violent offenders: a preliminary investigation. *Journal of Substance Use*, 22(3), 295–303.
- Albrecht, B., Staiger, P. K., Hall, K., Miller, P., Best, D., & Lubman, D. I. (2014). Benzodiazepine use and aggressive behaviour: a systematic review. *The Australian and New Zealand Journal of Psychiatry*, 48(12), 1096–1114.
- Amon, S., Putkonen, H., Weizmann-Henelius, G., Almiron, M. P., Formann, A. K., Voracek, M., ... Klier, C. M. (2012). Potential predictors in neonaticide: the impact of the circumstances of pregnancy. *Archives of Women's Mental Health*, 15(3), 167–174.
- Andersson, J., & Thiblin, I. (2018). National study shows that abusive head trauma mortality in Sweden was at least 10 times lower than in other Western countries. *Acta Paediatrica*, 107(3), 477–483.
- Asai, A., & Ishimoto, H. (2013). Should we maintain baby hatches in our society? *BMC Medical Ethics*, 14(1), 9.
- Azores-Gococo, N. M., Brook, M., Teralandur, S. P., & Hanlon, R. E. (2017). Killing a child: neuropsychological profiles of murderers of children. *Criminal Justice and Behavior*, 44(7), 946–962.
- Backe, S. N., & Andersson, R. (2008). Monitoring the “tip of the iceberg”: ambulance records as a source of injury surveillance. *Scandinavian Journal of Public Health*, 36(3), 250–257.
- Bae, S., Lee, J. S., Kim, K. H., Park, J., Shin, D. W., Kim, H., ... Jeon, W. (2017). Playground equipment related injuries in preschool-aged children: emergency department-based injury in-depth surveillance. *Journal of Korean Medical Science*, 32(3), 534–541.
- Bennett, D. J., Ogloff, J. R. P., Mullen, P. E., Thomas, S. D. M., Wallace, C., & Short, T. (2011). Schizophrenia disorders, substance abuse and prior offending in a sequential series of 435 homicides. *Acta Psychiatrica Scandinavica*, 124(3), 226–233.
- Bergink, V., Rasgon, N., & Wisner, K. L. (2016). Postpartum psychosis: madness, mania, and melancholia in motherhood. *The American Journal of Psychiatry*, 173(12), 1179–1188.

- Bévalot, F., Cartiser, N., Bottinelli, C., Fanton, L., & Guitton, J. (2016). Vitreous humor analysis for the detection of xenobiotics in forensic toxicology: a review. *Forensic Toxicology*, 34(1), 12–40.
- Biron, D., & Reynald, D. (2016). Developing a revised typology of child homicide. *Children Australia*, 41(1), 8–15.
- Bogstrand, S. T., Normann, P. T., Rossow, I., Larsen, M., Mørland, J., & Ekeberg, Ø. (2011). Prevalence of alcohol and other substances of abuse among injured patients in a Norwegian emergency department. *Drug and Alcohol Dependence*, 117(2–3), 132–138.
- Boles, S. M., & Miotto, K. (2003). Substance abuse and violence: a review of the literature. *Aggression and Violent Behaviour*, 8(2), 155–174.
- Boumba, V. A., Economou, V., Kourkoumelis, N., Gousia, P., Papadopoulou, C., & Vougiouklakis, T. (2012). Microbial ethanol production: experimental study and multivariate evaluation. *Forensic Science International*, 215(1–3), 189–198.
- Bourget, D., & Gagne, P. (2002). Maternal filicide in Quebec. *Journal of the American Academy of Psychiatry and the Law*, 30(3), 345–51.
- Bourget, D., & Gagné, P. (2005). Paternal filicide in Québec. *The Journal of the American Academy of Psychiatry and the Law*, 33(3), 354–60.
- Bourget, D., Grace, J., & Whitehurst, L. (2007). A review of maternal and paternal filicide. *The Journal of the American Academy of Psychiatry and the Law*, 35(1), 74–82.
- Bramness, J. G., Skurtveit, S., & Mørland, J. (2006). Flunitrazepam: psychomotor impairment, agitation and paradoxical reactions. *Forensic Science International*, 159(2–3), 83–91.
- Brookman, F., & Nolan, J. (2006). The dark figure of infanticide in England and Wales: complexities of diagnosis. *Journal of Interpersonal Violence*, 21(7), 869–889.
- Bye, E. (2008). Alcohol and homicide in Eastern Europe: a time series analysis of six countries. *Homicide Studies*, 12(1), 7–27.
- Camperio Ciani, A. S., & Fontanesi, L. (2012). Mothers who kill their offspring: testing evolutionary hypothesis in a 110-case Italian sample. *Child Abuse and Neglect*, 36(6), 519–527.
- Cavanagh, K., Dobash, R. E., & Dobash, R. P. (2005). Men who murder children inside and outside the family. *British Journal of Social Work*, 35(5), 667–688.
- Centers for Disease Control and Prevention. (2015). *National Violent Death Reporting System (NVDRS) Coding Manual Revised*.
- Chanen, A. M., Jackson, H. J., McGorry, P. D., Allot, K. a, Clarkson, V., & Yuen, H. P. (2004). Two-year stability of personality disorder in older adolescent outpatients. *Journal of Personality Disorders*, 18(6), 526–541.
- Chang, Z., Larsson, H., Lichtenstein, P., & Fazel, S. (2015). Psychiatric disorders and violent reoffending: a national cohort study of convicted prisoners in Sweden. *The Lancet Psychiatry*, 2(10), 891–900.
- Chang, Z., Lichtenstein, P., Långström, N., Larsson, H., & Fazel, S. (2016). Association between prescription of major psychotropic medications and violent reoffending after

- prison release. *JAMA*, 316(17), 1798–1807.
- Chen, Y. H., Chiou, H. Y., Tang, C. H., & Lin, H. C. (2010). Risk of death by unnatural causes during early childhood in offspring of parents with mental illness. *American Journal of Psychiatry*, 167(2), 198–205.
- Cochran, D. M., Dvir, Y., & Frazier, J. a. (2013). “Autism-plus” spectrum disorders. Intersection with psychosis and the schizophrenia spectrum. *Child and Adolescent Psychiatric Clinics of North America*, 22(4), 609–627.
- Cohen, L., & Felson, M. (1979). Social change and crime rate trends: a routine activity approach. *American Sociological Review*, 44(4), 588–608.
- Coid, J. (1983). The epidemiology of abnormal homicide and murder followed by suicide. *Psychological Medicine*, 13(4), 855–860.
- Coid, J., Ullrich, S., Bebbington, P., Fazel, S., & Keers, R. (2016). Paranoid ideation and violence: meta-analysis of individual subject data of 7 population surveys. *Schizophrenia Bulletin*, 42(4), 907–915.
- Coorg, R., & Tournay, A. (2012). Filicide-suicide involving children with disabilities. *Journal of Child Neurology*, 28(6), 745–751.
- Costanza, M. C. (1995). Matching. *Preventive Medicine*, 24(5), 425–33.
- Crandall, C. S., Jost, P. F., Broidy, L. M., Daday, G., & Sklar, D. P. (2004). Previous emergency department use among homicide victims and offenders: a case-control study. *Annals of Emergency Medicine*, 44(6), 646–655.
- Cros, J., Alvarez, J., Sbidian, E., Charlier, P., & Lorin de la Grandmaison, G. (2012). Homicidal deaths in the western suburbs of Paris. *The American Journal of Forensic Medicine and Pathology*, 33(4), 404–409.
- Daly, M., & Wilson, M. (1988). Evolutionary social psychology and family homicide. *Science*, 242(4878), 519–524.
- Daly, M., & Wilson, M. I. (1994). Some differential attributes of lethal assaults on small children by stepfathers versus genetic fathers. *Ethology and Sociobiology*, 15(4), 207–217.
- Darke, S. (2010). The toxicology of homicide offenders and victims: a review. *Drug and Alcohol Review*, 29(2), 202–215.
- Darke, S., & Duflou, J. (2008). Toxicology and circumstances of death of homicide victims in New South Wales, Australia 1996-2005. *Journal of Forensic Sciences*, 53(2), 447–451.
- Davies, H. T., Crombie, I. K., & Tavakoli, M. (1998). When can odds ratios mislead? *BMJ (Clinical Research Ed.)*, 316(7136), 989–91.
- Dawson, M. (2015). Canadian trends in filicide by gender of the accused, 1961-2011. *Child Abuse & Neglect*, 47, 162–74.
- De Muth, J. E. (2008). Preparing for the first meeting with a statistician. *American Journal of Health-System Pharmacy*, 65(24), 2358–2366.
- Debowska, A., Boduszek, D., & Dhingra, K. (2015). Victim, perpetrator, and offense

- characteristics in filicide and filicide–suicide. *Aggression and Violent Behavior*, 21, 113–124.
- Dinis-Oliveira, R. J., Carvalho, F., Duarte, J. A., Remião, F., Marques, A., Santos, A., & Magalhães, T. (2010). Collection of biological samples in forensic toxicology. *Toxicology Mechanisms and Methods*, 20(7), 363–414.
- Dinis-Oliveira, R. J., Vieira, D. N., & Magalhães, T. (2016). Guidelines for collection of biological samples for clinical and forensic toxicological analysis. *Forensic Sciences Research*, 1(1), 42–51.
- Dreyfus, J., Flood, A., Cutler, G., Ortega, H., Kreykes, N., & Kharbanda, A. (2016). Comparison of pediatric motor vehicle collision injury outcomes at level I trauma centers. *Journal of Pediatric Surgery*, 51(10), 1693–1699.
- Drummer, O. H., & Gerostamoulos, J. (2002). Postmortem drug analysis: analytical and toxicological aspects. *Therapeutic Drug Monitoring*, 24(2), 199–209.
- du Prel, J.-B., Hommel, G., Röhrig, B., & Blettner, M. (2009). Confidence interval or p-value?: part 4 of a series on evaluation of scientific publications. *Deutsches Ärzteblatt International*, 106(19), 335–9.
- Duke, A. A., Smith, K. M. Z., Oberleitner, L. M. S., Westphal, A., & Mckee, S. A. (2018). Alcohol, drugs, and violence: a meta-meta-analysis. *Psychology of Violence*, 8(2), 238–249.
- Durrant, J. E. (1999). Evaluating the success of Sweden’s corporal punishment ban. *Child Abuse and Neglect*, 23(5), 435–448.
- Eke, S. M., Basoglu, S., Bakar, B., & Oral, G. (2015). Maternal Filicide in Turkey. *Journal of Forensic Sciences*, 60(S1), S143–S151.
- Ellonen, N., Kääriäinen, J., Lehti, M., & Aaltonen, M. (2015). Comparing trends in infanticides in 28 countries, 1960–2009. *Journal of Scandinavian Studies in Criminology and Crime Prevention*, 16(2), 175–193.
- Erol, A., & Karpyak, V. M. (2015). Sex and gender-related differences in alcohol use and its consequences: contemporary knowledge and future research considerations. *Drug and Alcohol Dependence*, 156, 1–13.
- Escobedo, L. G., & Ortiz, M. (2002). The relationship between liquor outlet density and injury and violence in New Mexico. *Accident; Analysis and Prevention*, 34(5), 689–694.
- Falk, Ö., Wallinius, M., Lundström, S., Frisell, T., Anckarsäter, H., & Kerekes, N. (2014). The 1 % of the population accountable for 63 % of all violent crime convictions. *Social Psychiatry and Psychiatric Epidemiology*, 49(4), 559–571.
- Fazel, S., & Grann, M. (2004). Psychiatric morbidity among homicide offenders: a Swedish population study. *The American Journal of Psychiatry*, 161(11), 2129–2131.
- Fazel, S., Gulati, G., Linsell, L., Geddes, J. R., & Grann, M. (2009). Schizophrenia and violence: systematic review and meta-analysis. *Plos Medicine*, 6(8), e1000120.
- Fazel, S., Lichtenstein, P., Grann, M., Goodwin, G. M., & Långström, N. (2010). Bipolar disorder and violent crime: new evidence from population-based longitudinal studies and systematic review. *Archives of General Psychiatry*, 67(9), 931–938.

- Fazel, S., Långström, N., Hjern, A., Grann, M., & Lichtenstein, P. (2009). Schizophrenia, substance abuse, and violent crime. *JAMA*, 301(19), 2016–23.
- Fazel, S., Wolf, A., Chang, Z., Larsson, H., Goodwin, G. M., & Lichtenstein, P. (2015). Depression and violence : a Swedish population study. *The Lancet Psychiatry*, 2(3), 224–232.
- Fazel, S., Zetterqvist, J., Larsson, H., Långström, N., & Lichtenstein, P. (2014). Antipsychotics, mood stabilisers, and risk of violent crime. *The Lancet*, 384(9949), 1206–1214.
- First, M. B., Gibbon, M., Spitzer, R. L., Williams, J. B., & Smith Benjamin, L. (1997). *Structured Clinical Interview for DSM-IV – Axis II Disorders*. Washington D.C.: American Psychiatric Press.
- Flynn, S., Gask, L., Appleby, L., & Shaw, J. (2016). Homicide–suicide and the role of mental disorder: a national consecutive case series. *Social Psychiatry and Psychiatric Epidemiology*, 51(6), 877–884.
- Flynn, S., Shaw, J. J., & Abel, K. M. (2007). Homicide of infants: a cross-sectional study. *The Journal of Clinical Psychiatry*, 68(10), 1501–9.
- Flynn, S., Shaw, J. J., & Abel, K. M. (2013). Filicide: mental illness in those who kill their children. *PloS One*, 8(4), e58981.
- Frederick, J., Goddard, C., & Oxley, J. (2013). What is the “dark figure” of child homicide and how can it be addressed in Australia? *International Journal of Injury Control and Safety Promotion*, 20(3), 209–17.
- Goldstein, P. J. (1985). The drugs/violence nexus: a tripartite conceptual framework. *Journal of Drug Issues*, 15(4), 493–506.
- Golenkov, A., Large, M., Nielssen, O., & Tsymbalova, A. (2016). Homicide and mental disorder in a region with a high homicide rate. *Asian Journal of Psychiatry*, 23, 87–92.
- Granath, S., Hagstedt, J., Kivivuori, J., Lehti, M., Ganpat, S., Liem, M., & Nieuwbeerta, P. (2011). *Homicide in Finland, the Netherlands and Sweden: A First Study on the European Homicide Monitor Data*. Stockholm.
- Granath, S., & Sturup, J. (2018). Homicide clearance in Sweden 1990–2013 with special reference to firearm-perpetrated homicides. *Journal of Scandinavian Studies in Criminology and Crime Prevention*, 3858, 1–15.
- Grylli, C., Brockington, I., Fiala, C., Huscsava, M., Waldhoer, T., & Klier, C. M. (2016). Anonymous birth law saves babies - optimization, sustainability and public awareness. *Archives of Women's Mental Health*, 19(2), 291–297.
- Guenther, E., Knight, S., Olson, L. M., Dean, J. M., & Keenan, H. T. (2009). Prediction of Child Abuse Risk from Emergency Department Use. *The Journal of Pediatrics*, 154(2), 272–277.
- Haggård-Grann, U., Hallqvist, J., Långström, N., & Möller, J. (2006). The role of alcohol and drugs in triggering criminal violence: a case-crossover study. *Addiction*, 101(1), 100–108.
- Han, E., Kim, E., Hong, H., Jeong, S., Kim, J., In, S., ... Lee, S. (2012). Evaluation of

- postmortem redistribution phenomena for commonly encountered drugs. *Forensic Science International*, 219(1–3), 265–271.
- Harris, G. T., Hilton, N. Z., Rice, M. E., & Eke, A. W. (2007). Children killed by genetic parents versus stepparents. *Evolution and Human Behavior*, 28(2), 85–95.
- Hathaway, S., & McKinley, J. (2000). *Minnesota Multiphasic Personality Inventory – 2* (Swedish ed). Uppsala: Psykologiförlaget AB.
- Hatters Friedman, S., Cavney, J., & Resnick, P. J. (2012). Mothers who kill: evolutionary underpinnings and infanticide law. *Behavioral Sciences & the Law*, 30(5), 585–597.
- Hatters Friedman, S., Horwitz, S. M., & Resnick, P. J. (2005). Child murder by mothers: a critical analysis of the current state of knowledge and a research agenda. *American Journal of Psychiatry*, 162(9), 1578–1587.
- Hatters Friedman, S., Hrouda, D., Holden, C. E., Noffsinger, S. G., & Resnick, P. J. (2005). Filicide-suicide: common factors in parents who kill their children and themselves. *The Journal of the American Academy of Psychiatry and the Law*, 33(4), 496–504.
- Hatters Friedman, S., & Resnick, P. J. (2007). Child murder by mothers: patterns and prevention. *World Psychiatry*, 6(3), 137–41.
- Hatters Friedman, S., & Resnick, P. J. (2009). Neonaticide: phenomenology and considerations for prevention. *International Journal of Law and Psychiatry*, 32(1), 43–47.
- Hatters Friedman, S., Sorrentino, R. M., Stankowski, J. E., Holden, C. E., & Resnick, P. J. (2008). Psychiatrists' knowledge about maternal filicidal thoughts. *Comprehensive Psychiatry*, 49(1), 106–110.
- Hayat, M. J., & Higgins, M. (2014). Understanding poisson regression. *Journal of Nursing Education*, 53(4), 207–215.
- Heeramun, R., Magnusson, C., Gumpert, C. H., Granath, S., Lundberg, M., Dalman, C., & Rai, D. (2017). Autism and convictions for violent crimes: population-based cohort study in Sweden. *Journal of the American Academy of Child and Adolescent Psychiatry*, 56(6), 491–497.
- Herbert, A., Gilbert, R., Cottrell, D., & Li, L. (2017). Causes of death up to 10 years after admissions to hospitals for self-inflicted, drug-related or alcohol-related, or violent injury during adolescence: a retrospective, nationwide, cohort study. *The Lancet*, 6736(17), 1–10.
- Hess, L. M., Raebel, M. A., Conner, D. A., & Malone, D. C. (2006). Measurement of adherence in pharmacy administrative databases: a proposal for standard definitions and preferred measures. *Annals of Pharmacotherapy*, 40(7–8), 1280–1288.
- Hill, A. B. (1965). The environment and disease: association or causation? *Proceedings of the Royal Society of Medicine*, 58(5), 295–300.
- Hoaken, P. N. S., & Stewart, S. H. (2003). Drugs of abuse and the elicitation of human aggressive behavior. *Addictive Behaviors*, 28(9), 1533–1554.
- Hockin, S., Rogers, M. L., & Pridemore, W. A. (2017). Population-level alcohol consumption and national homicide rates. *European Journal of Criminology*, (online publication), 1–

- Holland, M. G., & Ferner, R. E. (2017). A systematic review of the evidence for acute tolerance to alcohol - the "Mellanby effect". *Clinical Toxicology*, 55(6), 545–556.
- Hwa, H.-L., Pan, C.-H., Shu, G.-M., Chang, C.-H., Lee, T.-T., & Lee, J. C.-I. (2015). Child homicide victims in forensic autopsy in Taiwan: a 10-year retrospective study. *Forensic Science International*, 257, 413–419.
- Igoumenou, A., Kallis, C., & Coid, J. (2015). Treatment of psychosis in prisons and violent recidivism. *British Journal of Psychiatry Open*, 1(2), 149–157.
- Im, D. S. (2016). Template to perpetrate: an update on violence in autism spectrum disorder. *Harvard Review of Psychiatry*, 24(1), 14–35.
- Isacsson, G., & Ahlner, J. (2014). Antidepressants and the risk of suicide in young persons - prescription trends and toxicological analyses. *Acta Psychiatrica Scandinavica*, 129(4), 296–302.
- Jason, J. (1983). Child homicide spectrum. *American Journal of Diseases of Children*, 137(6), 578–581.
- Johnson, E. M., & Belfer, M. L. (1995). Substance abuse and violence: cause and consequence. *Journal of Health Care for the Poor and Underserved*, 6(2), 113–123.
- Jones, A. W. (2016). *Alcohol: Acute and Chronic Use and Postmortem Findings. Encyclopedia of Forensic and Legal Medicine* (Vol. 1). Elsevier Ltd.
- Jones, A. W., & Fransson, M. (2003). Blood analysis by headspace gas chromatography: does a deficient sample volume distort ethanol concentration? *Medicine, Science and the Law*, 43(3), 241–247.
- Jones, I., Chandra, P. S., Dazzan, P., & Howard, L. M. (2014). Bipolar disorder, affective psychosis, and schizophrenia in pregnancy and the post-partum period. *The Lancet*, 384(9956), 1789–1799.
- Jones, K., Nielsen, S., Bruno, R., Frei, M., & Lubman, D. I. (2011). Benzodiazepines - their role in aggression and why GPs should prescribe with caution. *Australian Family Physician*, 40(11), 862–865.
- Kajese, T. M., Nguyen, L. T., Pham, G. Q., Pham, V. K., Melhorn, K., & Kallail, K. J. (2011). Characteristics of child abuse homicides in the state of Kansas from 1994 to 2007. *Child Abuse and Neglect*, 35(2), 147–154.
- Kauppi, A., Kumpulainen, K., Karkola, K., Vanamo, T., & Merikanto, J. (2010). Maternal and paternal filicides: a retrospective review of filicides in Finland. *The Journal of the American Academy of Psychiatry and the Law*, 38(2), 229–238.
- Kim, H. (2017). Statistical notes for clinical researchers: chi-squared test and Fisher's exact test. *Restorative Dentistry & Endodontics*, 42(2), 152–155.
- Klier, C. M., Grylli, C., Amon, S., Fiala, C., Weizmann-Henelius, G., Pruitt, S. L., & Putkonen, H. (2013). Is the introduction of anonymous delivery associated with a reduction of high neonaticide rates in Austria? A retrospective study. *BJOG: An International Journal of Obstetrics and Gynaecology*, 120(4), 428–434.
- Knoll, J. L. (2016). Understanding homicide–suicide. *Psychiatric Clinics of North America*,

- Knoll, J. L., & Hatters Friedman, S. (2015). The homicide-suicide phenomenon: findings of psychological autopsies. *Journal of Forensic Sciences*, 60(5), 1253–1257.
- Koenen, M. A., Thompson John W., J., Thompson, J. W. J., Tallandini, M., Thompson John W., J., & Tallandini, M. (2008). Filicide: historical review and prevention of child death by parent. *Infant Mental Health Journal*, 29(1), 61–75.
- Krabseth, H., Mörlund, J., & Höiseth, G. (2014). Assistance of ethyl glucuronide and ethyl sulfate in the interpretation of postmortem ethanol findings. *International Journal of Legal Medicine*, 128(5), 765–770.
- Kripke, D. F., Langer, R. D., & Kline, L. E. (2012). Hypnotics' association with mortality or cancer: a matched cohort study. *BMJ Open*, 2(1), 1–8.
- Kugelberg, F. C., & Jones, A. W. (2007). Interpreting results of ethanol analysis in postmortem specimens: a review of the literature. *Forensic Science International*, 165(1), 10–29.
- Kuhns, J. B., & Clodfelter, T. A. (2009). Illicit drug-related psychopharmacological violence: the current understanding within a causal context. *Aggression and Violent Behavior*, 14(1), 69–78.
- Kuhns, J. B., Exum, M. L., Clodfelter, T. a., & Bottia, M. C. (2013). The prevalence of alcohol-involved homicide offending: a meta-analytic review. *Homicide Studies*, 18(3), 251–270.
- Kuhns, J. B., Wilson, D. B., Clodfelter, T. A., Maguire, E. R., & Ainsworth, S. A. (2011). A meta-analysis of alcohol toxicology study findings among homicide victims. *Addiction*, 106(1), 62–72.
- Kuhns, J. B., Wilson, D. B., Maguire, E. R., Ainsworth, S. A., & Clodfelter, T. A. (2009). A meta-analysis of marijuana, cocaine and opiate toxicology study findings among homicide victims. *Addiction*, 104(7), 1122–1131.
- Lam, W. Y., & Fresco, P. (2015). Medication adherence measures: an overview. *BioMed Research International*, 1–12.
- Landberg, J., & Norström, T. (2011). Alcohol and homicide in Russia and the United States: a comparative analysis. *Journal of Studies on Alcohol and Drugs*, 72(5), 723–30.
- Large, M., Smith, G., & Nielssen, O. (2009a). The epidemiology of homicide followed by suicide: a systematic and quantitative review. *Suicide & Life-Threatening Behavior*, 39(3), 294–306.
- Large, M., Smith, G., & Nielssen, O. (2009b). The relationship between the rate of homicide by those with schizophrenia and the overall homicide rate: a systematic review and meta-analysis. *Schizophrenia Research*, 112(1–3), 123–129.
- Laursen, T. M., Munk-Olsen, T., Mortensen, P. B., Abel, K. M., Appleby, L., & Webb, R. T. (2011). Filicide in offspring of parents with severe psychiatric disorders: a population-based cohort study of child homicide. *The Journal of Clinical Psychiatry*, 72(5), 698–703.
- Lehane, E., & McCarthy, G. (2009). Medication non-adherence – exploring the conceptual

- mire. *International Journal of Nursing Practice*, 15(1), 25–31.
- Lehti, M. (2014). Homicide drop in Finland, 1996–2012. *Journal of Scandinavian Studies in Criminology and Crime Prevention*, 15(2), 182–199.
- Lehti, M., Kääriäinen, J., & Kivivuori, J. (2012). The declining number of child homicides in Finland, 1960–2009. *Homicide Studies*, 16(1), 3–22.
- Levitzky, S., & Cooper, R. (2000). Infant colic syndrome – maternal fantasies of aggression and infanticide. *Clinical Pediatrics*, 39(7), 395–400.
- Lew, M. (2013). To P or not to P: on the evidential nature of P-values and their place in scientific inference. *arXiv Preprint arXiv:1311.0081*, (December 2012), 1–31.
- Liem, M. (2010). Homicide followed by suicide: a review. *Aggression and Violent Behavior*, 15(3), 153–161.
- Liem, M., Barber, C., Markwalder, N., Killias, M., & Nieuwbeerta, P. (2011). Homicide-suicide and other violent deaths: an international comparison. *Forensic Science International*, 207(1–3), 70–76.
- Liem, M., Ganpat, S., Granath, S., Hagstedt, J., Kivivuori, J., Lehti, M., & Nieuwbeerta, P. (2013). Homicide in Finland, the Netherlands, and Sweden: first findings from the European Homicide Monitor. *Homicide Studies*, 17(1), 75–95.
- Liem, M., & Koenraadt, F. (2008). Familicide: a comparison with spousal and child homicide by mentally disordered perpetrators. *Criminal Behaviour and Mental Health*, 18(5), 306–18.
- Liem, M., Levin, J., Holland, C., & Fox, J. (2013). The nature and prevalence of familicide in the United States, 2000–2009. *Journal of Family Violence*, 28(4), 351–358.
- Liem, M., & Pridemore, W. A. (Eds.). (2012). *Handbook of European Homicide Research*. New York, NY: Springer New York.
- Lipton, R., & Gruenewald, P. (2002). The spatial dynamics of violence and alcohol outlets. *Journal of Studies on Alcohol*, 63(2), 187–195.
- Loayza, N., Crettol, S., Riquier, F., & Eap, C. B. (2012). Adherence to antidepressant treatment: what the doctor thinks and what the patient says. *Pharmacopsychiatry*, 45(5), 204–207.
- Ludvigsson, J. F., Almqvist, C., Bonamy, A. K. E., Ljung, R., Michaëlsson, K., Neovius, M., ... Ye, W. (2016). Registers of the Swedish total population and their use in medical research. *European Journal of Epidemiology*, 31(2), 125–136.
- Ludvigsson, J. F., Andersson, E., Ekblom, A., Feychting, M., Kim, J., Reuterwall, C., ... Olausson, P. O. (2011). External review and validation of the Swedish national inpatient register. *BMC Public Health*, 11, 1–16.
- Lundholm, L., Haggård, U., Möller, J., Hallqvist, J., & Thiblin, I. (2013). The triggering effect of alcohol and illicit drugs on violent crime in a remand prison population: a case crossover study. *Drug and Alcohol Dependence*, 129(1–2), 110–115.
- Lundström, S., Reichenberg, A., Anckarsäter, H., Lichtenstein, P., & Gillberg, C. (2015). Autism phenotype versus registered diagnosis in Swedish children: prevalence trends over 10 years in general population samples. *BMJ*, 350(apr28 2), h1961–h1961.

- Lysell, H., Runeson, B., Lichtenstein, P., & Långström, N. (2014). Risk factors for filicide and homicide. *The Journal of Clinical Psychiatry*, 75(2), 127–132.
- MacEwan, J. P., Forma, F. M., Shafrin, J., Hatch, A., Lakdawalla, D. N., & Lindenmayer, J.-P. (2016). Patterns of adherence to oral atypical antipsychotics among patients diagnosed with schizophrenia. *Journal of Managed Care & Specialty Pharmacy*, 22(11), 1349–1361.
- MacNeill, E. C., Cabey, W., Kluge, R., Norton, J., & Mitchell, A. M. (2016). Emergency department utilization in children <36 months is not an independent risk factor for maltreatment. *Academic Emergency Medicine*, 23(11), 1228–1234.
- Makhlouf, F., & Rambaud, C. (2014). Child homicide and neglect in France: 1991-2008. *Child Abuse and Neglect*, 38(1), 37–41.
- Malmquist, C. P. (2013). Infanticide/neonaticide: the outlier situation in the United States. *Aggression and Violent Behavior*, 18(3), 399–408.
- Manning, J. (2014). The social structure of homicide-suicide. *Homicide Studies*, 19(4), 350–369.
- Mariano, T. Y., Chan, H. C. O., & Myers, W. C. (2014). Toward a more holistic understanding of filicide: a multidisciplinary analysis of 32 years of U.S. arrest data. *Forensic Science International*, 236, 46–53.
- Martone, C. A., Mulvey, E. P., Yang, S., Nemoianu, A., Shugarman, R., & Soliman, L. (2013). Psychiatric characteristics of homicide defendants. *The American Journal of Psychiatry*, 170(9), 994–1002.
- Marzuk, P. M., Tardiff, K., & Hirsch, C. S. (1992). The epidemiology of murder-suicide. *JAMA*, 267(23), 3179–83.
- Mbughuni, M. M., Jannetto, P. J., & Langman, L. J. (2016). Mass spectrometry applications for toxicology. *The Journal of the International Federation of Clinical Chemistry and Laboratory Medicine*, 27(4), 272–287.
- McShane, B. B., Gal, D., Gelman, A., Robert, C., & Tackett, J. L. (2017). Abandon Statistical Significance. *arXiv.org*, 1–12.
- Medical Products Agency – Sweden. (2017). Retrieved June 17, 2017, from www.mpa.se
- Motulsky, H. (2014). *Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking* (Third edit). New York, NY: Oxford university Press.
- Mozayani, A., & Noziglia, C. (Eds.). (2011). *The Forensic Laboratory Handbook Procedures and Practice*. Totowa, NJ: Humana Press.
- Mugavin, M. E. (2005). A meta-synthesis of filicide classification systems: psychosocial and psychodynamic issues in women who kill their children. *Journal of Forensic Nursing*, 1(2), 65–72.
- National Board of Health and Welfare [Socialstyrelsen]. (2009). *Kvalitet och innehåll i patientregistret. Utskrivningar från slutenvården 1964–2007 och besök i specialiserad öppenvård (exklusive primärvårdsbesök) 1997–2007*. Stockholm.
- National Board of Health and Welfare [Socialstyrelsen]. (2013). *Causes of Death 2012*.

- Nielssen, O., & Large, M. (2010). Rates of homicide during the first episode of psychosis and after treatment: a systematic review and meta-analysis. *Schizophrenia Bulletin*, 36(4), 702–712.
- Nielssen, O., Malhi, G. S., & Large, M. M. (2012). Mania, homicide and severe violence. *The Australian and New Zealand Journal of Psychiatry*, 46(4), 357–63.
- Niven, D. J., Berthiaume, L. R., Fick, G. H., & Laupland, K. B. (2012). Matched case-control studies: a review of reported statistical methodology. *Clinical Epidemiology*, 4, 99–110.
- Nordlund, J., & Temrin, H. (2007). Do characteristics of parental child homicide in Sweden fit evolutionary predictions? *Ethology*, 113(11), 1029–1037.
- Norström, T. (2011). Alcohol and homicide in the United States: is the link dependent on wetness? *Drug and Alcohol Review*, 30(5), 458–65.
- Norström, T., & Ramstedt, M. (2005). Mortality and population drinking: a review of the literature. *Drug and Alcohol Review*, 24(6), 537–47.
- O’Neal, C. L., & Poklis, A. (1996). Postmortem production of ethanol and factors that influence interpretation: a critical review. *The American Journal of Forensic Medicine and Pathology*, 17(1), 8–20.
- Oberman, M. (1996). Mothers who kill: coming to terms with modern American infanticide. *American Criminal Law Review*, 34(1), 1–111.
- Osgood, D. W. (2000). Poisson-based regression analysis of aggregate crime rates. *Journal of Quantitative Criminology*, 16(1), 21–43.
- Ottesen, V. (2012). A current absence of neonaticide in Norway. *Scandinavian Journal of Forensic Science*, 18(2), 155–163.
- Palermo, M. T. (2003). Preventing filicide in families with autistic children. *International Journal of Offender Therapy and Comparative Criminology*, 47(1), 47–57.
- Panczak, R., Geissbühler, M., Zwahlen, M., Killias, M., Tal, K., & Egger, M. (2013). Homicide-suicides compared to homicides and suicides: systematic review and meta-analysis. *Forensic Science International*, 233(1–3), 28–36.
- Parker, R. N., Williams, K. R., McCaffree, K. J., Acensio, E. K., Browne, A., Strom, K. J., & Barrick, K. (2011). Alcohol availability and youth homicide in the 91 largest US cities, 1984-2006. *Drug and Alcohol Review*, 30(5), 505–514.
- Pearce, N. (2016). Analysis of matched case-control studies. *BMJ*, 352, 1–4.
- Pettersson, G., & Eriksson, A. (2014). Unnatural deaths must be investigated better--risk of crimes being missed. Examination of the police and the health care system management of deaths in three counties. *Läkartidningen*, 111(48), 2160–2.
- Porter, T., & Gavin, H. (2010). Infanticide and neonaticide: a review of 40 years of research literature on incidence and causes. *Trauma, Violence & Abuse*, 11(3), 99–112.
- Pridemore, W. A. (2002). Vodka and violence: alcohol consumption and homicide rates in Russia. *American Journal of Public Health*, 92(12), 1921–1930.
- Pridemore, W. A. (2011). Poverty matters: a reassessment of the inequality–homicide relationship in cross-national studies. *The British Journal of Criminology*, 51(5), 739–

- Pridemore, W. A., & Eckhardt, K. (2014). A comparison of victim, offender, and event characteristics of alcohol- and non-alcohol-related homicides. *Journal of Research in Crime and Delinquency*, 45(3), 227–255.
- Putkonen, H., Amon, S., Almiron, M. P., Cederwall, J. Y., Eronen, M., Klier, C., ... Weizmann-Henelius, G. (2009). Filicide in Austria and Finland - A register-based study on all filicide cases in Austria and Finland 1995-2005. *BMC Psychiatry*, 9(1), 74.
- Putkonen, H., Amon, S., Weizmann-Henelius, G., Pankakoski, M., Eronen, M., Almiron, M. P., & Klier, C. M. (2016). Classifying filicide. *International Journal of Forensic Mental Health*, 15(2), 198–210.
- Putkonen, H., Weizmann-Henelius, G., Collander, J., Santtila, P., & Eronen, M. (2007). Neonaticides may be more preventable and heterogeneous than previously thought - neonaticides in Finland 1980-2000. *Archives of Women's Mental Health*, 10(1), 15–23.
- Putkonen, H., Weizmann-Henelius, G., Lindberg, N., Eronen, M., & Häkkänen, H. (2009). Differences between homicide and filicide offenders; results of a nationwide register-based case-control study. *BMC Psychiatry*, 9, 27.
- Radovic, S., Meynen, G., & Bennet, T. (2015). Introducing a standard of legal insanity: The case of Sweden compared to The Netherlands. *International Journal of Law and Psychiatry*, 40, 43–49.
- Ramstedt, M. (2011). Population drinking and homicide in Australia: a time series analysis of the period 1950-2003. *Drug and Alcohol Review*, 30(5), 466–472.
- Raven, J. (1998). *Standard Progressive Matrices Sets A, B, C, D and E*. San Antonio: Pearson.
- Regoeczi, W. C., Granath, S., Issa, R., Gilson, T., & Sturup, J. (2016). Comparing homicide-suicides in the United States and Sweden. *Journal of Forensic Sciences*, 61(6), 1524–1530.
- Reich, R. R., Cummings, J. R., Greenbaum, P. E., Moltisanti, A. J., & Goldman, M. S. (2015). The temporal “pulse” of drinking: tracking 5 years of binge drinking in emerging adults. *Journal of Abnormal Psychology*, 124(3), 635–47.
- Resnick, P. (1969). Child murder by parents: a psychiatric review of filicide. *The American Journal of Psychiatry*, 126(3), 325–34.
- Resnick, P. (1970). Murder of the newborn: a psychiatric review of neonaticide. *The American Journal of Psychiatry*, 126(10), 1414–20.
- Rezansoff, S. N., Moniruzzaman, A., Fazel, S., McCandless, L., & Somers, J. M. (2017). Adherence to antipsychotic medication and criminal recidivism in a Canadian provincial offender population. *Schizophrenia Bulletin*, 43(5), 1002–1010.
- Roach, J., & Bryant, R. (2015). Child homicide: generating victim and suspect risk profiles. *Journal of Criminal Psychology*, 5(3), 201–215.
- Roberson, A. M., Castro, V. M., Cagan, A., & Perlis, R. H. (2016). Antidepressant nonadherence in routine clinical settings determined from discarded blood samples. *The Journal of Clinical Psychiatry*, 77(3), 359–62.

- Rodway, C., Flynn, S., While, D., Rahman, M. S., Kapur, N., Appleby, L., & Shaw, J. (2014). Patients with mental illness as victims of homicide: a national consecutive case series. *The Lancet Psychiatry*, 1(2), 129–134.
- Roe-Sepowitz, D. E. (2008). Comparing male and female juveniles charged with homicide: child maltreatment, substance abuse, and crime details. *Journal of Interpersonal Violence*, 24(4), 601–617.
- Roma, P., Pazzelli, F., Pompili, M., Lester, D., Girardi, P., & Ferracuti, S. (2012). Mental illness in homicide-suicide: a review. *The Journal of the American Academy of Psychiatry and the Law*, 40(4), 462–468.
- Rose, S., & van der Laan, M. (2009). Why match? Investigating matched case-control study designs with causal effect estimation. *The International Journal of Biostatistics*, 5(1), 1–24.
- Rothman, K. (2012). *Epidemiology An Introduction*. Oxford university Press.
- Rothman, K. (2014). Six persistent research misconceptions. *Journal of General Internal Medicine*, 29(7), 1060–1064.
- Rouve, N., Bagheri, H., Telmon, N., Pathak, A., Franchitto, N., Schmitt, L., ... Montastruc, J.-L. (2011). Prescribed drugs and violence: a case/noncase study in the French Pharmacovigilance Database. *European Journal of Clinical Pharmacology*, 67(11), 1189–1198.
- Roy, M., Prox-Vagedes, V., Ohlmeier, M. D., & Dillo, W. (2015). Beyond childhood: psychiatric comorbidities and social background of adults with Asperger syndrome. *Psychiatria Danubina*, 27(1), 50–59.
- Sahlin, H., Kuja-Halkola, R., Bjureberg, J., Lichtenstein, P., Molero, Y., Rydell, M., ... Hellner, C. (2017). Association between deliberate self-harm and violent criminality. *JAMA Psychiatry*, 74(6), 615–621.
- Sariaslan, A., Lichtenstein, P., Larsson, H., & Fazel, S. (2016). Triggers for violent criminality in patients with psychotic disorders. *JAMA Psychiatry*, 73(8), 796.
- Sariaslan, A., Långström, N., D’Onofrio, B., Hallqvist, J., Franck, J., & Lichtenstein, P. (2013). The impact of neighbourhood deprivation on adolescent violent criminality and substance misuse: a longitudinal, quasi-experimental study of the total Swedish population. *International Journal of Epidemiology*, 42(4), 1057–1066.
- Schulz, M., Iwersen-Bergmann, S., Andresen, H., & Schmoldt, A. (2012). Therapeutic and toxic blood concentrations of nearly 1,000 drugs and other xenobiotics. *Critical Care*, 16(4), R136.
- Schwartz-Watts, D. M. (2005). Asperger’s disorder and murder. *The Journal of the American Academy of Psychiatry and the Law*, 33(3), 390–393.
- Shackelford, T. K., Weekes-Shackelford, V. A., & Beasley, S. L. (2005). An exploratory analysis of the contexts and circumstances of filicide-suicide in Chicago, 1965-1994. *Aggressive Behavior*, 31(4), 399–406.
- Shackelford, T. K., Weekes-Shackelford, V. A., & Beasley, S. L. (2008). Filicide–suicide in Chicago, 1870-1930. *Journal of Interpersonal Violence*, 23(5), 589–599.

- Sharma, B. R. (2006). Historical and medico-legal aspects of infanticide: an overview. *Medicine, Science and the Law*, 46(2), 152–6.
- Sharps, P. W., Campbell, J., Campbell, D., Gary, F., & Webster, D. (2001). The role of alcohol use in intimate partner femicide. *The American Journal on Addictions*, 10(2), 122–35.
- Shaw, J., Hunt, I. M., Flynn, S., Amos, T., Meehan, J., Robinson, J., ... Appleby, L. (2006). The role of alcohol and drugs in homicides in England and Wales. *Addiction*, 101(8), 1117–1124.
- Shenoi, R., Levine, N., Donaruma-Kwoh, M. M., Lyn, M. A., Hunter, J. V., & Giardino, A. P. (2013). The Spatial Relationship of Child Homicides to Community Resources in a Large Metropolitan Area. *SAGE Open*, 3(2), 1–14.
- Shenoi, R., Nassif, A., Camp, E. A., & Pereira, F. A. (2017). Previous emergency medical services use by victims of child homicide. *Pediatric Emergency Care*, 0(0), 1–7.
- Sher, L., & Rice, T. (2015). Prevention of homicidal behaviour in men with psychiatric disorders. *The World Journal of Biological Psychiatry*, 16(4), 212–29.
- Shupe, L. M. (1954). Alcohol and crime. A study of the urine alcohol concentration found in 882 persons arrested during or immediately after the commission of a felony. *Journal of Criminal Law, Criminology and Police Science*, 44(5), 661–664.
- Sidebotham, P., Bailey, S., Belderson, P., & Brandon, M. (2011). Fatal child maltreatment in England, 2005-2009. *Child Abuse and Neglect*, 35(4), 299–306.
- Silva, J. a, Leong, G. B., Dassori, A., Ferrari, M. M., Weinstock, R., & Yamamoto, J. (1998). A comprehensive typology for the biopsychosociocultural evaluation of child-killing behavior. *Journal of Forensic Sciences*, 43(6), 1112–8.
- Simpson, A. I. F., Skipworth, J., Mckenna, B., Moskowitz, A., & Barry-Walsh, J. (2006). Mentally abnormal homicide in New Zealand as defined by legal and clinical criteria: a national study. *Australian and New Zealand Journal of Psychiatry*, 40(9), 804–809.
- Sipsma, H. L., Canavan, M. E., Rogan, E., Taylor, L. A., Talbert-Slagle, K. M., & Bradley, E. H. (2017). Spending on social and public health services and its association with homicide in the USA: an ecological study. *BMJ Open*, 7(10), 1–7.
- Smith, M. L., Vorce, S. P., Holler, J. M., Shimomura, E., Magluilo, J., Jacobs, A. J., & Huestis, M. A. (2007). Modern instrumental methods in forensic toxicology. *Journal of Analytical Toxicology*, 31(5), 237–53, 8A–9A.
- Somander, L. K., & Rammer, L. M. (1991). Intra- and extrafamilial child homicide in Sweden 1971-1980. *Child Abuse & Neglect*, 15(1–2), 45–55.
- Sorenson, S. B., Wiebe, D. J., & Berk, R. a. (2002). Legalized abortion and the homicide of young children: an empirical investigation. *Analyses of Social Issues and Public Policy*, 2(1), 239–256.
- Stevens, H., Laursen, T. M., Mortensen, P. B., Agerbo, E., & Dean, K. (2015). Post-illness-onset risk of offending across the full spectrum of psychiatric disorders. *Psychological Medicine*, 45(11), 2447–2457.
- Stickley, A., & Razvodovsky, Y. (2012). The effects of beverage type on homicide rates in

- Russia, 1970–2005. *Drug and Alcohol Review*, 31(3), 257–262.
- Stoltzfus, J. C. (2011). Logistic regression: a brief primer. *Academic Emergency Medicine*, 18(10), 1099–1104.
- Sturup, J., & Caman, S. (2015). Homicide–suicide offences: description, classification and short case studies. *Journal of Criminal Psychology*, 5(3), 177–187.
- Sturup, J., & Granath, S. (2015). Child homicides in Sweden: a descriptive study comparing the 1990s and the 2000s. *Homicide Studies*, 19(2), 175–187.
- Sturup, J., Karlberg, D., & Kristiansson, M. (2015). Unsolved homicides in Sweden: A population-based study of 264 homicides. *Forensic Science International*, 257(1–2), 106–113.
- Sturup, J., Rostami, A., Gerell, M., & Sandholm, A. (2018). Near-repeat shootings in contemporary Sweden 2011 to 2015. *Security Journal*, 31(1), 73–92.
- Stöckl, H., Dekel, B., Morris-Gehring, A., Watts, C., & Abrahams, N. (2017). Child homicide perpetrators worldwide: a systematic review. *BMJ Paediatrics Open*, 1(1), 1–7.
- Svennerlind, C., Nilsson, T., Kerekes, N., Andiné, P., Lagerkvist, M., Forsman, A., ... Malmgren, H. (2010). Mentally disordered criminal offenders in the Swedish criminal system. *International Journal of Law and Psychiatry*, 33(4), 220–6.
- Svensson, J., & Landberg, J. (2013). Is youth violence temporally related to alcohol? A time-series analysis of binge drinking, youth violence and total alcohol consumption in Sweden. *Alcohol and Alcoholism*, 48(5), 598–604.
- Swedish Penal Code, Pub. L. No. 1962:700 (1962). The Swedish Code of Statutes.
- Swinson, N., Flynn, S., While, D., Roscoe, A., Kapur, N., Appleby, L., & Shaw, J. (2011). Trends in rates of mental illness in homicide perpetrators. *The British Journal of Psychiatry*, 198(6), 485–489.
- Tanaka, C. T., Berger, W., Valenca, A. M., Coutinho, E. S. F., Jean-Louis, G., Fontenelle, L. F., & Mendlowicz, M. V. (2017). The worldwide incidence of neonaticide: a systematic review. *Archives of Women's Mental Health*, 20(2), 249–256.
- Tanskanen, A., Taipale, H., Koponen, M., Tolppanen, A.-M., Hartikainen, S., Ahonen, R., & Tiihonen, J. (2015). From prescription drug purchases to drug use periods – a second generation method (PRE2DUP). *BMC Medical Informatics and Decision Making*, 15(1), 1–13.
- Taylor, P. J., & Kalebic, N. (2018). Psychosis and homicide. *Current Opinion in Psychiatry*, 32, 1–8.
- Temrin, H., Buchmayer, S., & Enquist, M. (2000). Step-parents and infanticide: new data contradict evolutionary predictions. *Proceedings. Biological Sciences / The Royal Society*, 267(1446), 943–945.
- Temrin, H., Nordlund, J., & Sterner, H. (2004). Are stepchildren over-represented as victims of lethal parental violence in Sweden? *Proceedings. Biological Sciences*, 271 Suppl(table 1), S124–6.
- Tiihonen, J., Lehti, M., Aaltonen, M., Kivivuori, J., Kautiainen, H., Virta, L. J., ... Korhonen, P. (2015). Psychotropic drugs and homicide: a prospective cohort study from Finland.

- Tiihonen, J., Suokas, J. T., Suvisaari, J. M., Haukka, J., & Korhonen, P. (2012). Polypharmacy with antipsychotics, antidepressants, or benzodiazepines and mortality in schizophrenia. *Archives of General Psychiatry*, 69(5), 476–483.
- Tomlinson, M. F., Brown, M., & Hoaken, P. N. S. (2016). Recreational drug use and human aggressive behavior: a comprehensive review since 2003. *Aggression and Violent Behavior*, 27, 9–29.
- Trägårdh, K., Nilsson, T., Granath, S., & Sturup, J. (2017). A time trend study of Swedish male and female homicide offenders from 1990 to 2010. *International Journal of Forensic Mental Health*, 15(2), 125–135.
- United Nations Office on Drugs and Crime. (2014). *Global Study on Homicide 2013*.
- United Nations Office on Drugs and Crime. (2017). *World Drug report 2017. Executive summary. Conclusion and policy implications of the world drug report 2017*.
- van Dorn, R., Volavka, J., & Johnson, N. (2012). Mental disorder and violence: is there a relationship beyond substance use? *Social Psychiatry and Psychiatric Epidemiology*, 47(3), 487–503.
- Vandenbroucke, J. P., von Elm, E., Altman, D. G., Gøtzsche, P. C., Mulrow, C. D., Pocock, S. J., ... Egger, M. (2007). Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. *Plos Medicine*, 4(10), e297.
- Velligan, D. I., Lam, Y.-W. F., Glahn, D. C., Barrett, J. A., Maples, N. J., Ereshefsky, L., & Miller, A. L. (2005). Defining and assessing adherence to oral antipsychotics: a review of the literature. *Schizophrenia Bulletin*, 32(4), 724–742.
- Viera, A. J. (2008). Odds ratios and risk ratios: what's the difference and why does it matter? *Southern Medical Journal*, 101(7), 730–734.
- Volavka, J. (2013). Violence in schizophrenia and bipolar disorder. *Psychiatria Danubina*, 25(1), 24–33.
- von Hofer, H. (2003). Crime and punishment in Sweden: historical criminal justice statistics 1750-2000. *Journal of Scandinavian Studies in Criminology and Crime Prevention*, 4(2), 162–179.
- Wahlsten, P., Koiranen, V., & Saukko, P. (2007). Survey of medico-legal investigation of homicides in the city of Turku, Finland. *Journal of Forensic and Legal Medicine*, 14(5), 243–252.
- Webb, R. T., Pickles, A. R., Appleby, L., Mortensen, P. B., & Abel, K. M. (2007). Death by unnatural causes during childhood and early adulthood in offspring of psychiatric inpatients. *Archives of General Psychiatry*, 64(3), 345–52.
- Wechsler, D. (2008). *Wechsler Adult Intelligence Scale–IV (WAIS–IV)*. San Antonio: Pearson.
- Weeke, A., & Oberwittler, D. (2017). A Comparison of Note Writers and No Note Writers in Homicide-Suicide Cases in Germany. *Archives of Suicide Research : Official Journal of the International Academy for Suicide Research*, 0(0), 1–9.
- Weekes-Shackelford, V. A., & Shackelford, T. K. (2004). Methods of filicide: stepparents

- and genetic parents kill differently. *Violence and Victims*, 19(1), 75–81.
- Wei, H. S., & Chen, J. K. (2014). Filicide-suicide ideation among Taiwanese parents with school-aged children: prevalence and associated factors. *Child Abuse and Neglect*, 38(3), 468–478.
- Weiss, D. B., Santos, M. R., Testa, A., & Kumar, S. (2016). The 1990s homicide decline. *Homicide Studies*, 20(4), 321–334.
- West, S. G. (2007). An overview of filicide. *Psychiatry*, 4(2), 48–57.
- Wettermark, B., Hammar, N., Fored, C. M., MichaelFored, C., Leimanis, A., Otterblad Olausson, P., ... Rosén, M. (2007). The new Swedish Prescribed Drug Register--opportunities for pharmacoepidemiological research and experience from the first six months. *Pharmacoepidemiology and Drug Safety*, 16(7), 726–35.
- Wiest, M. M., Lee, K. J., & Carlin, J. B. (2015). Statistics for clinicians: an introduction to logistic regression. *Journal of Paediatrics and Child Health*, 51(7), 670–673.
- Wilczynski, A. (1997). Prior agency contact and physical abuse in cases of child homicide. *British Journal of Social Work*, 27(9), 241–253.
- Wissing, D. R., & Timm, D. (2012). Statistics for the nonstatistician. *Southern Medical Journal*, 105(3), 126–130.
- Witt, K., van Dorn, R., & Fazel, S. (2013). Risk factors for violence in psychosis: systematic review and meta-regression analysis of 110 studies. *Plos One*, 8(2), 1–15.
- World Health Organization. (1987). *International Statistical Classification of Diseases and Related Health Problems, Ninth Revision*.
- World Health Organization. (1996). *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*.
- World Health Organization. (2003). *Adherence to long-term therapies. World Health Organization*. Geneva.
- World Health Organization. (2017). World Health Organization. Retrieved July 1, 2017, from http://www.who.int/substance_abuse/terminology/abuse/en/
- Xiang, P., Shen, M., & Drummer, O. H. (2015). Review: drug concentrations in hair and their relevance in drug facilitated crimes. *Journal of Forensic and Legal Medicine*, 36, 126–135.
- Yarema, M. C., & Becker, C. E. (2005). Key Concepts in postmortem drug redistribution. *Clinical Toxicology*, 43(4), 235–241.
- Yoon, J.-H., Kim, J.-H., Choi, S. S., Lyu, M. K., Kwon, J.-H., Jang, Y.-I., & Park, G.-T. (2012). Homicide and bipolar I disorder: a 22-year study. *Forensic Science International*, 217(1–3), 113–118.